Chapter 4

SYSTEM MODULE

CHAPTER 4 – SYSTEM MODULE

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System Module DB6

Baseband Block

Introduction

The baseband block is designed for a handportable phone, that operates in the DCS1900 system. The purpose of the baseband module is to control the phone and process audio signals to and from the RF block. The module also controls the user interface.

Technical Summary

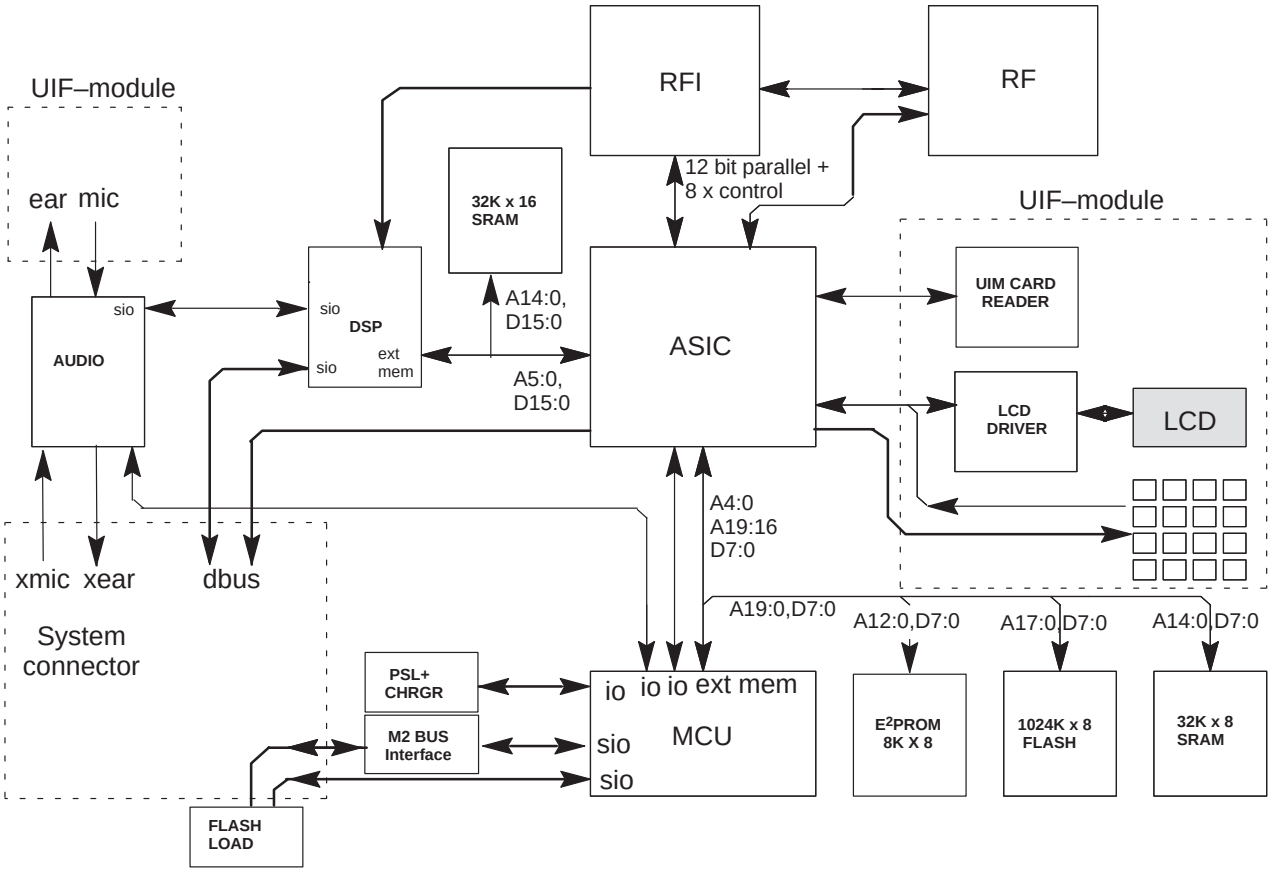
All functional baseband blocks are mounted on a single 6–layer printed circuit board. This board contains also RF parts. The chassis of the radio unit has separating walls for baseband and RF. All components of the baseband section are surface mountable. They are soldered using reflow. The connections to accessories are taken through the bottom connector of the radio unit. The connections to the User Interface module (UIF) are fed through a flex connector. There is no physical connector between the RF and baseband sections.

List of submodules:

CTRLU	Control Unit for the phone
PWRU	Power supply
DSPU	Digital Signal Processing block
AUDIO	Audio coding
ASIC	D2CA GSM/PCN ASIC
RFI	RF – baseband interface

The blocks above are only functional blocks and therefore have no type or material codes.

Interconnection Diagram



Technical Specifications

Modes of Operation

There are four different operation modes

– active mode

– idle mode

– power off mode

– local mode

In the active state all circuits are powered and part of the module may be in idle mode.

The module is usually in the idle mode when there is no call and the phone is in SERV. In the idle mode circuits are reset, powered down and clocks are stopped or the frequency reduced. All the clocks except the main clock from VCTCXO can be stopped in that mode. Whether the UIM clock is stopped or not depends on the network and UIM card type.

In power off mode only the circuits needed for power up are powered. This means that only power up block inside the PSL+ is powered. The power key on the flex is pulled up with a pull up resistor inside the PSL+.

The local mode is used for alignment and testing.

Supply Voltages and Power Consumption

Pin/Conn.	Symbol	Notes
VBATT/sys	VBATT	• min/typ/max 5.3 /6.0 /8.6 V sw limit • min/typ/max 4.5 /6.0 /8.9±0.3 V hw limit • min/typ/max 4.5 /6.0 /7.3±0.3 V hw limit during a call
	VA1	• min/typ/max 4.5 / 4.65 /4.8 V Imax = 40 mA
	VA2	• min/typ/max 4.5 / 4.65 /4.8 V Imax = 80 mA
	VL1	• min/typ/max 4.5 / 4.65 /4.8 V Imax = 150 mA
	VL2	• min/typ/max 4.5 / 4.65 /4.8 V Imax = 150 mA
	VREF	• min/typ/max 4.55 / 4.65 /4.75 V Imax = 5 mA
14/sys	VF	• min/typ/max 11.4 /12 /12.6 V Flash programming voltage
8,16/sys	VCHAR	• min/typ/max 10 /12 /13.5 V Charger voltage, when Isink<730 mA • min/typ/max 730 /800 /870 mA Charger current, when Uin<10 V

Control Signals

Pin/Con	Symbol	Notes
5/sys	M2BUS	• min/max 0 /0.7 V Input low level • min/max 3.0 /4.8 V Input high level • min/typ/max 0 /0.2 /0.35 V Output low level • min/typ/max 3.6 /4.65 /4.8V Output high level
6/sys	HOOK_RXD2	• Connected to MCU A/D input • min/typ/max 4.1 /4.65 /4.8 V (not in use) • min/typ/max 3.0 /3.45 /4.0 V Headset adapter and plug are connected • min/typ/max 1.9 /2.35 /2.9 V Hook off in compact HF • min/typ/max 0 /0.5 /0.7 V Hook on in compact HF

Pin/Con	Symbol	Notes
6/sys	HOOK_RXD2	• Flash loading data • min/typ/max 0 /0.2 /0.7 V Input low level • min/typ/max 3.6 /4.65 /4.8 V Input high level
7/sys	PHFS TXD2	• Power control for PHF–1 • min/typ/max 0 /0.2 /0.7 V Output low, power off • min/typ/max 3.6 /4.65 /4.8 V Output high, power on • Flash loading acknowledgedata • min/typ/max 0 /0.2 /0.7 V Output low level • min/typ/max 3.6 /4.65/4.8 V Output high level
15/sys	DCLK	• DBUS clock 512 kHz • min/typ/max 3.6 /4.65 /4.8 V State ”1” • min/typ/max 0 /0.2 /0.7 V State ”0”
11/sys	DSYNC	• DBUS sync 8 kHz • min/typ/max 3.6 /4.65 /4.8 V State ”1” • min/typ/max 0 /0.2 /0.7 V State ”0”
4/sys	TDA	• DBUS transmitted data from HP • min/typ/max 3.6/4.65/4.8 V State ”1”, 1mA load • min/typ/max 0 /0.2 /0.7 V State ”0”
12/sys	RDA	• DBUS received data to HP min/typ/max 3.6/4.65/4.8 V State ”1” • min/typ/max 0 /0.2 /0.7 V State ”0”
13/sys	BENA	• typ 0 V Headset power off • min/typ 4.4 /4.6 V Headset power on
4/UIF	BACKLIGHT	• Display and keyboard illumination control • min/max 0 /0.7 V Output low, backlights off • min/typ/max 4.5 /4.65 / 4.8 V Output high, backlights on
5–8/UIF	UIF(0:3)	• Keyboard row lines read. Display data lines write. • min/max 0 /0.7 V Output/Input low • min/max 4.5 /4.8 V Output/Input high
9/UIF	UIF4	• Keyboard row read. Write strobe for LCD driver • min/max 0 /0.7 V Output/Input low • min/max 4.5 /4.8 V Output/Input high

Pin/Con	Symbol	Notes
10/UIF	UIF5	• Keyboard row read. LCD driver register select • min/max 0 /0.7 V Output/Input low • min/max 4.5 /4.8 V Output/Input high
11/UIF	UIF6	• Enable strobe for LCD driver • min/max 0 /0.7 V Output/Input low • min/max 4.5 /4.8 V Output/Input high
12/UIF	MIC ENA	• min/max 0 /0.7 V Output low, microphone bias on • Floating, microphone off
13–16/ UIF	COL(0:3)	• Keyboard columns • min/max 0 /0.7 V Output low • min/max 4.5 /4.8 V Output high
17/UIF	CALL LED	• min/max 0 /0.7 V Output low, call led off • min/typ/max 4.5/ 4.65/ 4.8 V Output high, call led on
22/UIF	BUZZER	• PWM output from MCU • min/max 0 /0.7 V Output low, buzzer off • min/typ/max 4.5/ 4.65/ 4.8 V Output high, buzzer on
23/UIF	XPWRON	• min/typ/max 0 /0 /0.7 V Input low, power on/off • typ 4.65 V Floating when inactive. A pull–up in PSL+
25/UIF	UIMCLK	• Clock for UIM card • min/typ/max 3.6 /4.65 /4.8 V State ”1” • min/typ/max 0 /0.2 /0.7 V State ”0” • min/max 1 MHz /5 MHz UIM card clock frequency
26/UIF	UIMRESET	• Reset for UIM card • min/typ/max 4.5/ 4.65/ 4.8 V Output high • min/max 0 /0.7 V Output low
27/UIF	VUIM	• min/typ/max 4.5/ 4.65/ 4.8 V UIM card reader supply voltage • max 10 mA UIM card supply current at any frequency • max 100 µA UIM card supply current in idle state at 1 MHz and 25°C
28/UIF	UIMDATA	• Data for UIM card In/Out • min/typ/max 3.6 /4.65 /4.8 V State ”1” • min/typ/max 0 /0.2 /0.7 V State ”0”

Pin/Con	Symbol	Notes
BTYPE/ sys	BTYPE	• A pullup in phone. 47 kΩ resistor series with 100 kΩ resistor and transitor C–E paraller connection • min/typ/max 0.88 /0.98 /1.09 V 400mAh/15kΩ (pull resistor in the battery pack) • min/typ/max 1.02 /1.13 /1.25 V 500 mA/18kΩ • min/typ/max 1.86 /2.02 /2.20 V 950 mA/47kΩ battery don‘t be in accessorylist • min/typ/max 2.03 /2.20 /2.37 V, 1100 mAh/56 kΩ • min/typ/max 2.22 /2.39 /2.58 V, 1200 mAh/68 kΩ battery don‘t be in access.list • min/typ/max 2.58 /2.76 /2.95 V, 1500 mAh/100 kΩ • min/typ/max 3.30 /3.48 /3.66 V, Lithium/270 kΩ,battery don‘t be in access.list • min/typ/max 1.02 /1.13 /1.25 V, Vibra 500 mAh/18 kΩ
BTEMP/ sys	TBAT	• A 100 kΩ pull–up resistor in HP • typ 3.49 V , at – 5 C • typ 2.97 V , at +5 C,Battery temperature cold limit • typ 2.86 V , at +7 C • typ 1.23 V , at +40 C • typ 0.97 V , at +48 C, Battery temperature hot limit • Vibra Battery control. PWM output from MCU. DC separated.

Connector to UIF Module

Signal name	Pin	Notes
VL1	1	Logic supply voltage 4.65V
GND	2	Ground
VBATT	3,30	Battery voltage
BACKLIGHT	4	Backlights on/off
UIF(0:3)	5–8	Lines for keyboard read and LCD–controller data
UIF4	9	Line for keyboard read and LCD–controller read/write strobe

Signal name	Pin	Notes
UIF5	10	Line for keyboard read and LCD–controller data/instruction register selection
UIF6	11	LCD–controller enable strobe
MIC_ENA	12	Microphone bias enable
COL(0:3)	13–16	Lines for keyboard write
CALL_LED	17	Call led enable
MICP	18	Microphone (positive node)
MICN	19	Microphone (negative node)
EARP	20	Earpiece (negative node)
EARN	21	Earpiece (positive node)
BUZZER	22	PWM signal buzzer control
XPWRNON	23	Power key (active low)
VA1	24	Analog supply voltage 4.65V
UIMCLK	25	Clock for UIM data
UIMRESET	26	Reset for UIM
VUIM	27	UIM voltage supply
UIMDATA	28	Serial data for UIM
GND	29	Analog ground. Connected directly to digital ground on the PCB.

System Connector X100

Signal name	pin	Notes
GND	1,9	Digital ground.
MIC_JCONN	2	External audio input from accessories or handsfree microphone. Multiplexed with junction box connection indication. 16.8k pull down in HP
AGND	3	Analog ground for accessories. Connected directly to digital ground on the PCB.
TDA	4	Transmitted DBUS–data to the accessories
M2BUS	5	Serial bidirectional data and control between the handphone and accessories.

Signal name	Pin	Notes
HOOK_RXD2	6	HOOK–indication. The phone has a 100kΩ pull–up resistor. Data to flash from flash programmer.
PHFS_TXD2	7	Hands–free device power on/off. Data to flash programming device.
VCHAR	8,16	Battery charging voltage.
EAR_HFPWR	10	External audio output to accessories or handsfree speaker. 100kW pull–down in HP to turn on the junction box.
DSYNC	11	DBUS–data bit sync clock.
RDA	12	DBUS received data from the accessories.
BENA	13	Power supply to headset adapter.
VF	14	Programming voltage for flash from Flash box.
DCLK	15	DBUS–data clock.
GND	BGND	Ground
TBAT	BTEMP	Battery temperature and vibrabattery control
BTYPE	BTYPE	Battery type
VBATT	B+	Battery voltage
VCHAR	DC+	Battery charging voltage
VCHAR	CH+	Battery charging voltage
GND	GND	Charging ground, also phone ground

Internal Signals and Connections

Signals between RF and ASIC

Signal Name	Function	Notes
SCLK	Synthesizer clock	ASIC–>RF
SDATA	Synthesizer data	ASIC–>RF
SENA1	Synthesizer enable, UHF and VHF PLL enable	ASIC–>RF
RXPWR	RX supply voltage ON/OFF	ASIC–>RF
SYNTHPWR	Synthesizer supply voltage ON/OFF	ASIC–>RF
TXPWR	TX supply voltage ON/OFF	ASIC–>RF
TXP	Transmitter power control enable	ASIC–>RF

Signal Name	Function	Notes
TXL	Transmitter low power enable, ”0” = low power, ”1” = normal power	ASIC–>RF
RFC	26 MHz clock to ASIC CLKIN	RF –> ASIC

Signals between RF and RFI

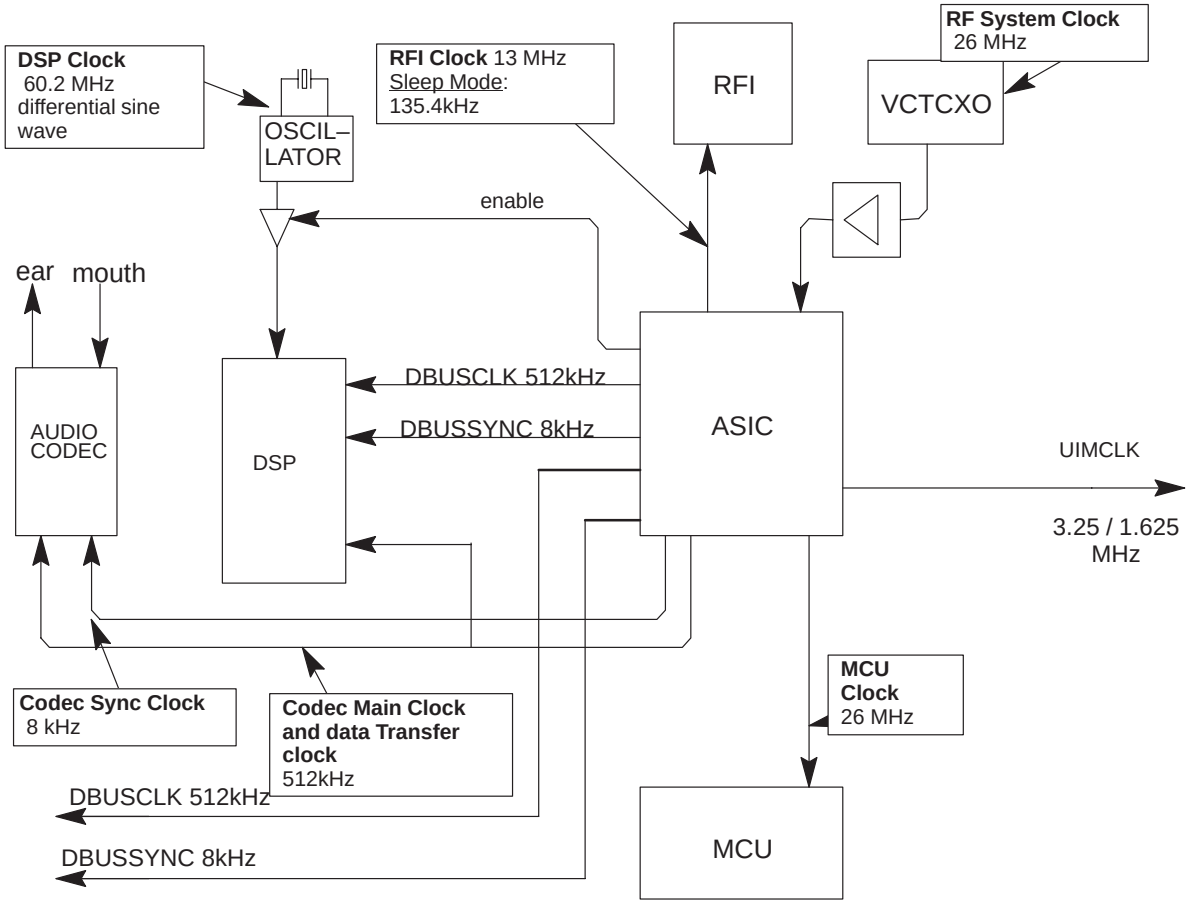
Signal Name	Functions	Notes
AFC	Automatic frequency control voltage	RFI –> RF
TXC	TX transmit power control voltage, AGC control in receiving	RFI –> RF
TXQP,TXQN	differential TX quadrature signal	RFI –> RF
TXIP,TXIN	differential TX inphase signal	RFI –> RF
PDATA0	front end AGC control	RFI –> RF
RXQ	RX quadrature signal	RF –> RFI
RXI	RX inphase signal	RF –> RFI

Signals between RF and CTRLU

Signals name	Function	Notes
TRF	RF temperature	RF –> CTRLU

Functional Description

Clocking Scheme Diagram



Circuit Description

Most of the clocks are generated from the 26 MHz VCTCXO frequency by the ASIC:

– 26 MHz clock for the MCU. MCU‘s internal clock frequency is half of that (13 MHz).

– 13 MHz for the RFI. The ASIC also generates 135.4 kHz sleep mode clock for the RFI.

– 3.25 MHz clock for UIM. When there is no data transfer between the UIM card and the HP the clock can be reduced to 1.625 MHz. Some UIM cards also allows the clock to be stopped in that mode.

– 512 kHz main clock for the codec and for the data transfer between the DSP and the codec.

– 8 kHz syncronisation clock for data transfer between the DSP and the codec.

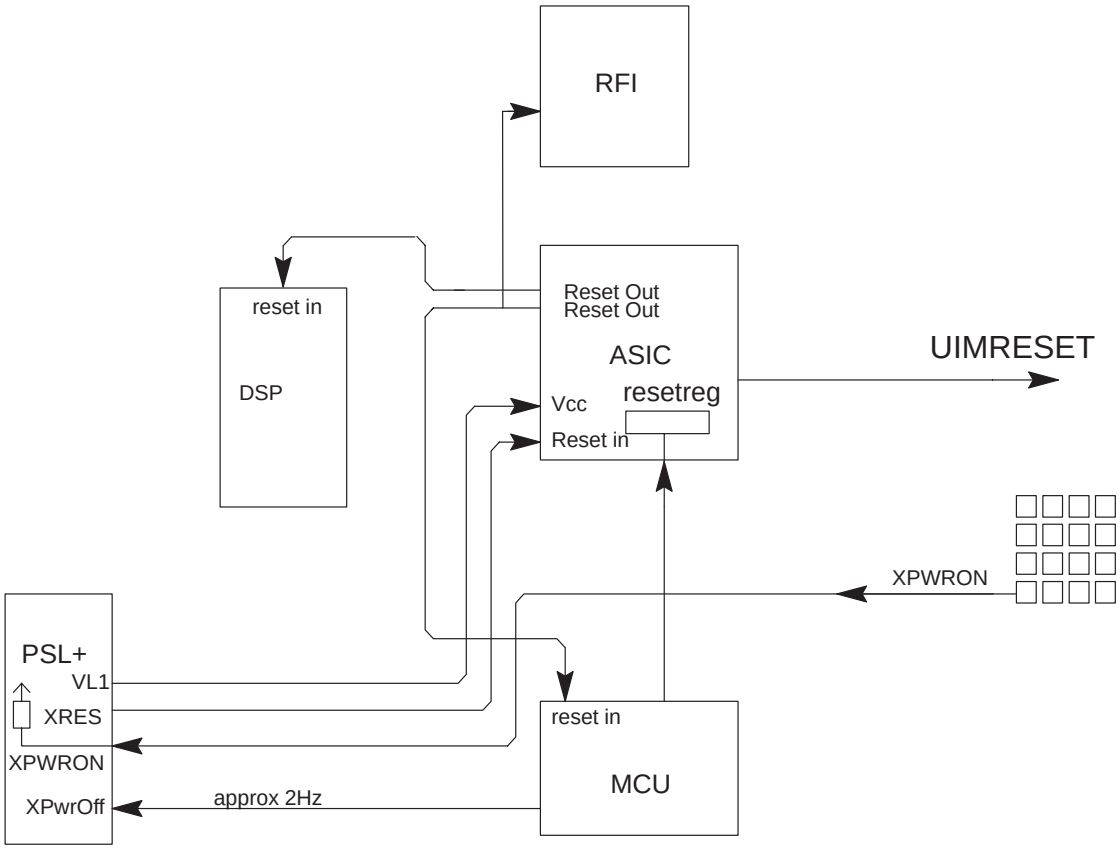
– 512 kHz clock and 8 kHz sync. clock for the DBUS data transfer.

The DSP has its own crystal oscillator which can be turned off and on by the ASIC. The DSP uses differential sinusoidal clock. The frequency is 60.2 MHz.

The MCU generates 8 kHz clock to the codec for the control data transfer.

In the idle mode all the clocks can be stopped except 26 MHz main clock coming from the VCTCXO.

Reset and Power Control Diagram



Circuit Description

There are three different ways to switch power on:

– Power key pressing grounds the XPWRON line. The PSL+ detects that and switches the power on.

– Charger detection on PSL+ detects that charger is connected and switches power on.

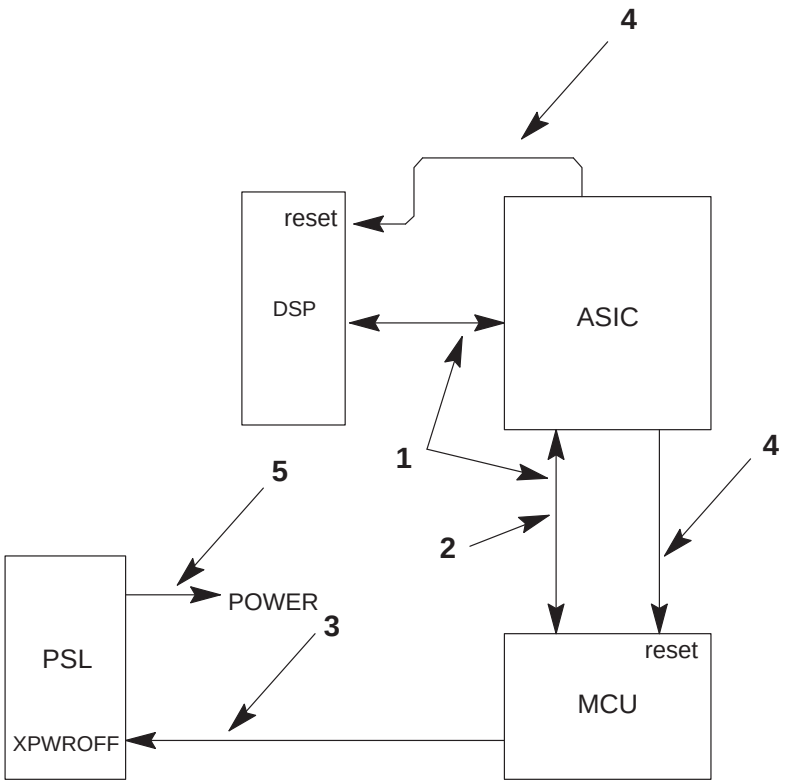
– PSL+ will switch power on when the battery is connected. After that the MCU will detect if power key is pressed or charger connected. If not the power will be switched off.

All devices are powered up at the same time by the PSL+. It supplies the reset to the ASIC at power up. The ASIC starts the clocks to the DSP and the MCU. After about 20us the ASIC releases the resets to MCU, RFI and DSP. MCU and RFI reset is released after 256 13 MHz clock cycles. DSP reset release time from DSP clock activation can be selected from 0 to 255 13MHz clock cycles. In our case it is 255. UIM reset release time is according to DSC1900 UIM specifications.

To turn off power for the phone, the user presses the PWR key. The MCU detects this. The MCU cuts off any ongoing call, exits all tasks, acts inoperative to the user and leaves the PSL+ watchdog without resets. After power–down delay, the PSL+ cuts off the supply from all circuitry.

If charging is on the phone stays on but it looks to the user like it is powered off (lights are off and the display is blank) except the charging indicator stays on.

Watchdog System Diagram



Circuit Description

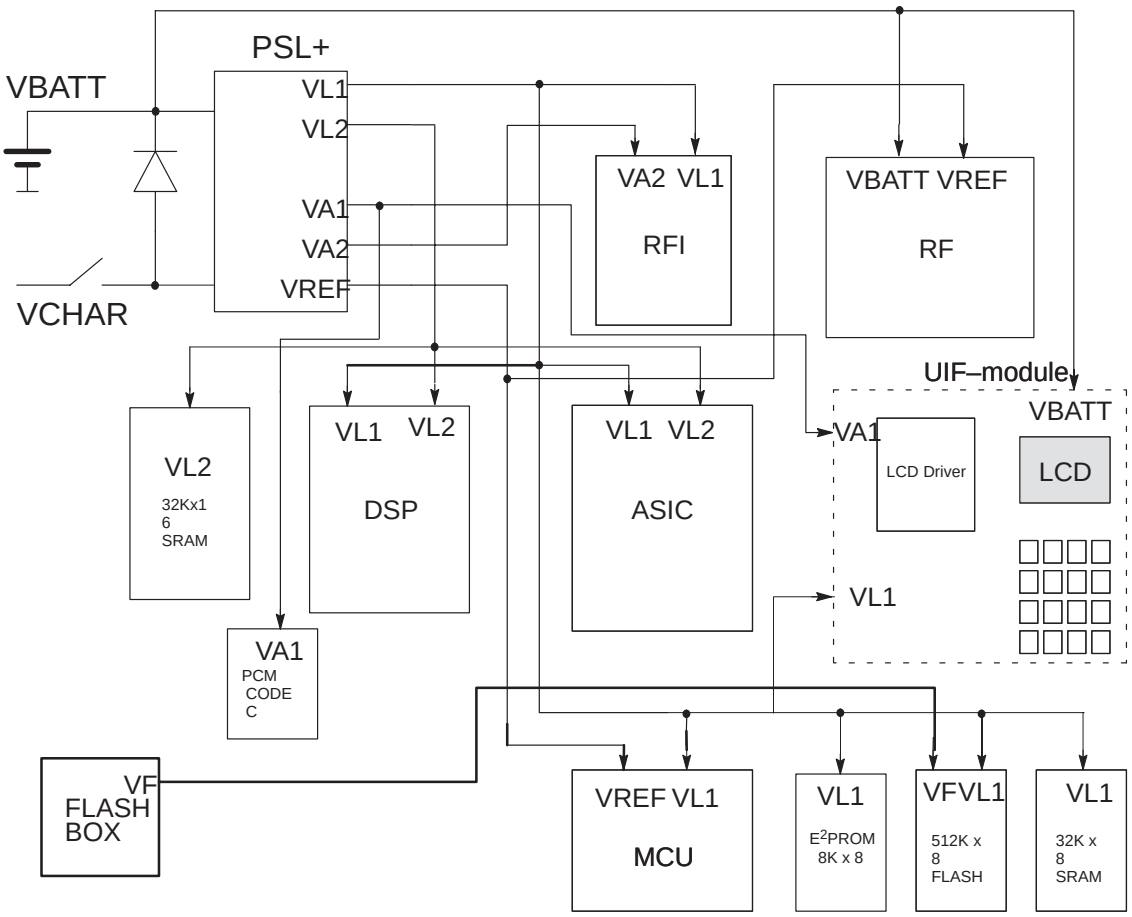
Normal operation:

1. MCU tests DSP
2. MCU updates ASIC watchdog timer (> 2Hz)
3. MCU pulses the XPWROFF input on the PSL+ (about 2Hz)

Failed operation:

4. ASIC resets MCU and DSP after about 0.5 s failure
5. PSL+ switches power off about1.5 s after the previous XPWROFF pulse

Power Distribution Diagram



Circuit Description

PSL+ control supply voltages. VL1 and VL2 are supply voltages to the logic circuits. VA1 and VA2 are supply voltages to the audio circuits. VREF is A/D converter and RF reference voltage. VBATT is fed directly to the circuits which need higher operation voltage and more current like RF transmitter and UIF backlight. VF is flash programming voltage, which is fed from flash box.

PSL+ output voltages are active, when PSL+ is in power on state.

CTRLU

Introduction

The Control block contains a microcomputer unit (MCU) and three memory circuits (FLASH, SRAM, EEPROM), a 20–bit address bus and an 8–bit data bus.

Main Features of the CTRLU Block

MCU functions:

– system control
– communication control
– user interface functions
– authentication
– RF monitoring
– power up/down control
– accessory monitoring
– battery monitoring and charging control
– self–test and production testing
– flash loading

External Signals and Connections, Inputs

Signal name	Signal description	From
VL1	Power supply voltage for CTRLU block	PWRU
VREF	Reference voltage for MCU AD–converter	PWRU
VBATDET	Battery voltage detection	PWRU
VC	Charger voltage monitoring	PWRU
EROMSELX	Chip select for the EEPROM memory	ASIC
ROMSELX	Chip select for the FLASH memory	ASIC
RAMSELX	Chip select for the SRAM memory	ASIC
RESETX	Reset signal for MCU	ASIC
NMI	Non–maskable interrupt request	ASIC
MCUCLK	Main clock for MCU	ASIC
IRQX	Interrupt request	ASIC
PCMCDO	Audio codec control data receiving	AUDIO
TRF	RF–module temperature detection	RF
VF	Programming voltage for flash memory	system con.
HOOK_RXD2	The use of handsfree monitoring. Flash programming data input on the production line.	system con.

Signal name	Signal description	From
TBAT	Battery temperature detection and vibrabattery control	system con.
BTYPE	Battery size identification	system con.
JCONN	Junction box connection identification	AUDIO
ROMAD18	Rom address 18, (paging)	ASIC

External Signals and Connections, Outputs

Signal name	Signal description	To
XPWROFF	Power off control, PSL+ watchdog reset	PWRU
PWM	Charger on/off control	PWRU
WSTROBEX	MCU write strobe	ASIC
RSTROBEX	MCU read strobe	ASIC
MCUAD(19:0)	20–bit MCU address bus	ASIC
MBUSDET	MBUS activity detection	ASIC
PCMCLK	Clock for audio codec control data transfer	AUDIO
PCMCDI	Audio codec control data transmitting	AUDIO
XSELPCMC	Chip select for audio codec	AUDIO
PHFS_TXD2	Power on/off control for HF device. Verification output of the programmed data of FLASH during programming.	system con.
CALL_LED	’Incoming’ call indicator light control	UIF conn.
BACKLIGHT	LCD and display backlight on/off control	UIF conn.
BUZZER	Buzzer signal	UIF conn.
VOLTUM	Software charging voltage limit	PWRU
BATDET	Detect battery removing and give to ASIC warning, ASIC drive UIM card down	ASIC

External Signals and Connections, Bidirectional

Signal name	Signal description	To/From
MCUDA(7:0)	MCU‘s 8–bit data bus	ASIC
M2BUS	Asynchronous serial data bus	system conn.

Block Description

MCU – Memories:

The MCU has a 20 bits wide address bus A(19:0) and an 8–bit data bus with memories. The address bits A(19:16) are used for chip select decoding. The decoding is done in the D2CA ASIC. The ASIC can address two 4 Mbit (or smaller) or one 8 Mbit flash memories. Hitachi HD647536 processor has 60kbyte internal ROM and 2kbyte RAM memories. One wait state is used in flash memory access.

Flash programming

In flash programming a special flash programming box and a PC is needed. Loading is done through the bottom connector of HP; multiplexed with HOOK_RXD2 and PHFS_TXD2 line. First MCU goes to minimum mode (MBUS command from PC or if MBUS is connected to MIC_JCONN line in power up). Then the flash software is loaded from PC to flash loading box. When the loading is complete flash loading to HP can be started by MBUS command from PC to the MCU. After that the MCU asks the test box to start flash loading to HP. The box supplies 12 V programming voltage for flash and starts to send 250 bytes data blocks to the MCU via HOOK_RXD2 line. The baud rate is 406 kbit/s. The MCU calculates the check sum, sends acknowledge via PHFS_TXD2 line and sends the data to flash. When all the data is loaded the HP makes reset and tells the flash loading box if the loading was succeeded or not. Only PSL+, ASIC and MCU must be active during the loading.

CTRLU – PWRU

MCU controls the watchdog timer in PSL+. It sends a positive pulse at approximately 2 Hz to XPWROFF pin of the PSL+ to keep the power on. If MCU fails to deliver this pulse, the PSL+ will remove power from the system. MCU also controls the charger on/off switching in the PWRU block. When power off is requested or MCU leaves PSL+ watchdog without reset. After the watchdog time has elapsed PSL+ cuts off the supply voltages from the phone.

CTRLU – ASIC

MCU and ASIC have a common 8–bit data bus and a 9–bit address bus. Bits A(4:0) are used for normal addressing whereas bits A(19:16) are decoded in ASIC to chip select inputs for CTRLU memories. ASIC controls the main clock, main reset and interrupts to MCU. The internal clock of MCU is half the MCUCLK clock speed. RESETX resets everything in MCU except the contents of the RAM. IRQX is a general purpose interrupt request line from ASIC. After IRQX request the interrupt register of the ASIC is read to find out the reason for interrupt. NMI interrupt is used only to wake up MCU from software standby mode.

CTRLU – DSPU

MCU and DSP communicate through ASIC. ASIC has an MCU mailbox and a DSP mailbox. MCU writes data to DSP mailbox where DSP can only read the incoming data. In MCU mailbox the data transfer direction is the opposite. When power is switched on the MCU loads data from the flash memory to DSP‘s external memory through this mailbox.

CTRLU – AUDIO

CTRLU control audio selections MIC/XMIC, EAR/XEAR and those lines gains. Also CTRLU control tone, ring and dtmf generator.

When MCU drive the chip select signal XSELPCMC low, MCU writes or reads control data to or from the speech codec registers at the rate defined by PCMCLK. PCMCDI is an output data line from MCU to codec and PCMCDO is an input data line from codec to MCU.

CTRLU – RF/BATTERY Monitoring

MCU has internal 8 channel 10 bit AD converter. Following signals are used to monitor battery, charging, accessories and RF:

BTYPE battery size

TBAT battery temperature (used also for vibrabattery control)

VBATDET battery voltage

VC charging voltage

TRF RF temperature

CTRLU – UIF

UIM card, keyboard and display interface goes through ASIC.

BUZZER, BACKLIGHT and CALL_LED are controlled directly from MCU.

CTRLU – ACCESSORIES

M2BUS is used to control external accessories. This interface can also be used for factory testing and maintenance purposes.

PHFS_TXD2 is used to turn power on to HF accessories.

JCONN is used to indicate that junction box is connected. DC level come from system connector line MIC_JCONN. Phone can also enter minimum mode when M2BUS is connected to MIC_JCONN line.

TBAT is used to control vibrabattery. (Used also for battery temperature measurement.)

HOOK indicates accessories hook state. Line is connected to MCU A/D–input.

JCONN is used to indicate that junction box is connected. DC level comes from system connector line MIC_JCONN. . . Phone can also enter minimum mode when M2BUS is connected to MIC_JCONN line. Line is connected to MCU A/D–input.

Main Components

Hitachi H8/536:

H8/536 is a CMOS microcontroller unit (MCU) comprising a CPU core and on–chip supporting modules with 16–bit architecture. The data bus to outside world has 8 bits.

1024k*8bit FLASH memory:

150 ns. maximum read access time (MCU need 1 wait state)

contains the main program code for the MCU; part of the DSP program code is also located on FLASH

ASIC can address two 4Mbit memories or one 8Mbit memory.

32k*8bit SRAM memory:

100 ns. maximum read access time

8k*8bit paraller EEPROM memory:

150 ns. maximum read access time

contains user defined information

there is a register bit on the ASIC which must be set before the write operation to the EEPROM.

PWRU

Introduction

The power block creates the supply voltages for the baseband block and contains the charging electronics.

External Signals and Connections, Inputs

Signal name	Signal description	From
XPWRON	PWR on switch	UIF
XPWROFF	Power off control	CTRLU
VBATT	Battery voltage	system conn.
PWM	Charger on/off control	CTRLU
VCHAR	Charging voltage	system conn.
VOLTLIM	Software charger voltage limit	CTRLU

External Signals and Connections, Outputs

Signal name	Signal description	To
XRES	Master reset	ASIC
VL1	Logic supply voltage. Max 150 mA	CTRLU,ASIC, RFI,UIF,DSPU
VL2	Logic supply voltage. Max 150 mA	DSPU,ASIC
VA1	Analog supply voltage. Max 40 mA	AUDIO,UIF
VA2	Analog supply voltage. Max 80 mA	RFI
VREF	Reference voltage 4.65 V±2% Max 5 mA	CTRLU,RFI
VBATDET	Switched VBATT divided by 2	CTRLU
VC	Attenuated VCHAR	CTRLU
CHRDET	Charger detection	ASIC

Block Description

The PSL+ IC produces the following supply voltages:

2 * VL	150mA for logic
VA1	40mA for audios
VA2	80mA for RFI
VREF	5mA reference

In addition, it has internal watchdog, voltage detection and charger detection functions. The watchdog will cut off output voltages if it is not reset once in every 1.5 (+/– 0.75) second. The voltage detector resets the phone if the battery voltage falls below 4.7 V (+/–0.2V). The charger detection starts the phone if it is in power–off state when the charging voltage is applied.

The charging electronics is controlled by the MCU. When the charging voltage is applied to the phone and the phone is powered up, the MCU detects it and starts controlling charging. If MCU detects too high charging voltage (over 14 volts) or current (over 78 A/D bit difference between VC and VBATDET) it will cut off the charging. The phone will accept charging voltages from 5 to 14 volts.

If the phone is in power–off state, the PSL+ will detect the charging voltage and turn on the phone. If the battery voltage is high enough the reset will be released and the MCU will start controlling charging. If the battery voltage is too low the phone stays in reset state and the charging control circuitry will pass charging current to the battery. When the battery voltage has reached 5.25 V (+/– 0.2 V) the reset will be removed and the MCU starts controlling charging.

MCU controls the charging with pulse width modulation output. Charging voltage is limited by hardware in normal operation to 8.9 V and during a call to 7.6 V.

Battery and charging voltages are calibrated in production; 6V is fed to the battery and charger pin and the MCU‘s A/D converter values are stored to EEPROM

Main components

PSL+ ASIC

Generates voltages, contains power on switch, charger and battery voltage detector and watchdog.

transistor BCP69–25 and Schottky STPS340U

The charging current is passed through these components.

transistor BCX51 and BCP69–25

VL regulators of PSL+ external output transistors.

DSPU

Introduction

Main interfaces of the DSP:

– MCU via ASIC mailbox

– RFI via ASIC

– ASIC

– audio codec

– data bus interface (DBUS) for accessories

– digital audio interface (DAI) for type approval measurements

Main features of the DSP block:

– speech processing

  speech coding/decoding

    – RPE–LTP–LPC (regular pulse excitation long term prediction linear predictive coding)

  voice activity detection (VAD) for discontinuous transmission (DTX)

  comfort noise generation during silence

  acoustic echo cancellation

– channel coding and transmission

  block coding (with ASIC)

  convolutional coding

  interleaving

  ciphering (with ASIC)

  burst building and writing it to ASIC

– Reception

  reading A/D conversion results from ASIC

  impulse response calculation

  matched filtering

  bit detection (with Viterbi on ASIC)

  deinterleaving of soft decisions

  convolutional decoding (with Viterbi)

  block decoding (with ASIC)

- Adjacent cell monitoring
  - signal strength measurements
  - neighbour timing measurements
  - neighbour parameter reception
- control functions
  - RF controls
    - synthesizer control
    - power ramp programming
    - automatic gain control (AGC)
    - automatic frequency control (AFC)
  - frame structure control
    - control of operations during a TDMA frame (with ASIC)
    - control of multiframe structure
    - channel configuration control
- test functions
  - functions for RF measurements
  - debugging functions for product development

Technical Description

External Signals and Connections, Inputs

Signal name	Signal description	From
VL1	Logic supply voltage. Max 150 mA.	PWRU
VL2	Logic supply voltage. Max 150 mA.	PWRU
DSP1RSTX	Reset for the DSP	ASIC
DSPCLKEN	Clock enable for DSP clock oscillator circuit	ASIC
PCMDATRCLKX	PCM data input clock. DBUS data input clock	ASIC
PCMCOSYCLKX	PCM data bit sync clock	ASIC
CODEC_CLK	PCM data output clock	ASIC
DBUSCLK	DBUS data output clock	ASIC
DBUSSYNC	DBUS data bit sync clock	ASIC
PCMOUT	Received audio in PCM format	AUDIO
RDA	DBUS received data	system conn
INT0, INT1	Interrupts for the DSP	ASIC

External Signals and Connections, Outputs

Signal name	Signal description	To
PCMIN	Transmitted audio in PCM format	AUDIO
TDA	DBUS transmitted data	System conn
IOX	I/O enable. Indicates access to DSP address space.	ASIC
RWX	Read/WriteX	ASIC
DSPAD(16:0)	Address bus and control signals	ASIC
DBUSDET	DBUS activity detection	ASIC

External Signals and Connections, Bidirectional

Signal name	Signal description	To/From
DSPDA(15:0)	16–bit data bus	ASIC

Block Description

The Control unit communicates with the DSP circuitry through a mailbox in the D2CA ASIC. The software for the external memories are loaded through this mailbox in start up.

The DSP includes two serial busses. One is used for speech data transfer between the DSP and the codec. The other is used as an external data bus and it is connected to the system connector. This bus can be used by data accessories and also as a digital audio interface (DAI) in audio type approval measurements. The clocks (512 kHz main clock and 8 kHz sync. clock) are generated by the ASIC.

In transmit mode the DSP codes the speech and routes the resulting transmit slots to the D2CA. The D2CA ASIC controls timing, and at specified intervals sends these bits to the RFI for DA conversion.

In digital receive mode the RFI AD converts the IF signal from the RF unit under the control of the D2CA. The DSP controls the D2CA and receives the converted bits. After channel and speech decoding, bits are converted into an analog signal in the PCM codec, routed and fed to the earpiece.

The DSP controls the RF through the D2CA ASIC, where all necessary timing functions are implemented, and control I/O lines are provided eg. for synte loading.

The DSP emulator can be connected to pins TCK, TMS, TDO, TDI, GND, VDD

Main Components

– AT&T DSP1616–S11

Digital signal processor with 12kword internal ROM

– Two 32k *8 70ns SRAMs for DSP external memory

– 60.2 MHz crystal oscillator to generate differential small signal clock for the DSP, clock enable come from ASIC

AUDIO

Introduction

The AUDIO block consists of an audio codec with some peripheral components. The codec contains microphone and earpiece amplifier and all the necessary switches for routing. The codec is controlled by the MCU. The PCM coded data comes from and goes to the DSP.

Technical Specification

External Signals and Connections, Inputs

Signal name	Signal description	From
VA1	Analog supply voltage. Max 40 mA.	PWRU
PCMIN	Received audio in PCM format	DSPU
SYNC	8kHz frame sync	ASIC
CODEC_CLK	512kHz codec main clock	ASIC
PCMCDI	Audio codec control data	CTRLU
PCMCLK	Clock for audio codec control data transfer	CTRLU
XSELPCMC	Audio codec chip select	CTRLU
MIC_JCONN	External microphone	System conn
MICN,MICP	Differential microphone signal	UIF conn

External Signals and Connections, Outputs

Signal name	Signal description	To
PCMOUT	Transmitted audio in PCM–format	DSPU
PCMCDO	Audio codec control data	CTRLU
MIC_ENA	Microphone enable	UIF
EAR_HFPWR	External received audio	System conn
EARN,EARP	Internal received audio	UIF
JCONN	Junction box connected signal (multiplexed with HFMIC)	CTRLU

Block Description

The codec has two microphone inputs and two earphone outputs. Handportable and external audios can therefore be connected directly to the codec. The codec has internal switches to select which input or output is used. It also has microphone amplifier and earphone attenuator. Input/output selection and amplification/attenuation can be done with codec register settings. The register control is done by the MCU.

Handportable microphone and earphone (located on the flex) are connected directly to the codec‘s differential input and output. External audios are connected single sided. There is 21 dB attenuation in the external microphone line before the codec to prevent clipping.

Microphone signal is routed to the microphone amplifier. After that it is fed to the bandpass filter and then to the A/D converter. After the conversion the digital data is sent to the DSP.

Digital downlink signal from the DSP is fed to the D/A converted. After the converter there is a low pass filter and attenuator before the earphone output. All these are inside the codec. The ASIC generates the 512 kHz and 8 kHz clocks for the codec and data transmission between the codec and the DSP.

The audio codec communicates with the DSP (analog speech) through a SIO (signals: PCMIN, SYNC, CODEC_CLK and PCMOUT) . The MCU controls the audio codec function through a separate serial bus (signals: PCMCDO, PCMCDI, PCMCLK and XSELPCMC).

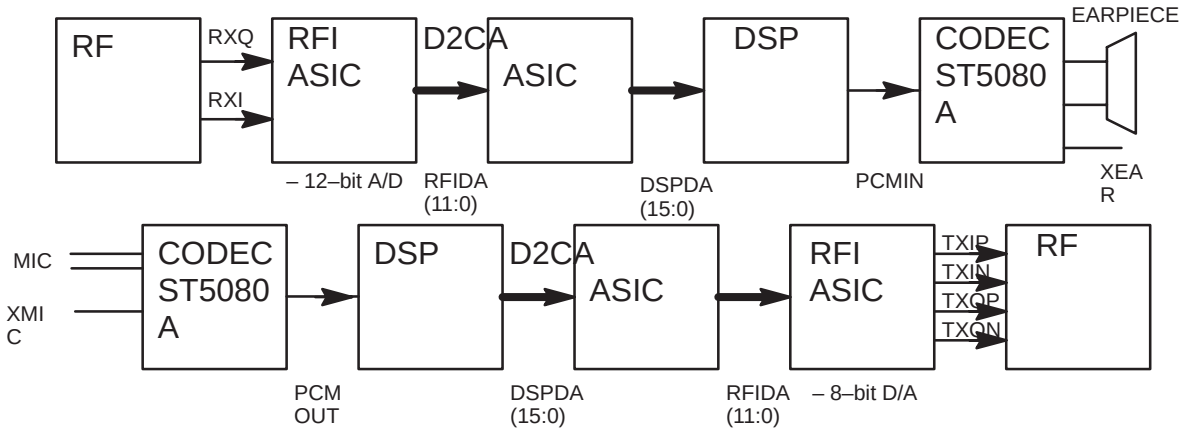
The codec generates DTMF tones (key beeps) to the earphone and in HF mode to the external speaker. In portable mode the MCU generates ringing tones and also some warning tones to the buzzer. In HF mode they are generated by the codec and driven to the external speaker line. Some tones come also from the network.

One codec output pin is used to switch on/off the microphone bias circuit on the flex.

External microphone line (MIC_JCONN) is used also to detect if junction box is connected to the bottom connector. Microphone signal is therefore routed to the MCU A/D converter.

Also external earphone signal is multiplexed. 100 kohm pull down resistor is used to turn power on to the HF accessories

Audio Route



Main components

Audio codec ST5080:

Contains e.g. PCM codec, audio routing switches, microphone and earpiece amplifiers for 2 connections (internal and external devices) and DTMF generator.

ASIC

Introduction

The ASIC takes care of the following functions:

– interface between MCU and UIF

– interface between MCU, DSP and RFI

– hardware accelerator functions to DSP

– clock generation and disable/enable

– RF controls

– UIF interface

– Timers

– M2BUS interface

– UIM interface

Technical Specification

External Signals and Connections, Inputs

Signal name	Signal description	From
VL1	Logic supply voltage. Max 150 mA.	PWRU
VL2	Logic supply voltage. Max 150 mA.	PWRU
VA1	Logic supply voltage. Max 40 mA.	PWRU
IOX	I/O enable. Indicates access to DSP address space.	DSPU
RWX	Read/WriteX	DSPU
WSTROBEX	MCU’s write strobe	CTRLU
RSTROBEX	MCU’s read strobe	CTRLU
RFC	reference clock from VCTCXO	RF
XRES	Master reset	PWRU
DSPAD(16:0)	Address bus and control signals	DSPU
MCUAD(19:0)	MCU’s address bus, A(19:16) and A(4:0) connected	CTRLU
DAX	Data acknowledge	RFI
MBUSDET	MBUS activity detection	CTRLU
DBUSDET	DBUS activity detection	DSPU

Signal name	Signal description	From
BATDET	Battery on place detection, if line go to ”0”, ASIC have interrupt and drive UIM card down.	CTRLU
CHRDET	Charger voltage detection, ”0”=no charger, ”1”=charger connected	PWRU

External Signals and Connections, Outputs

Signal name	Signal description	To
INT0,INT1	Interrupts for DSP	DSPU
NMI	Not maskable interrupt request	CTRLU
IRQX	Interrupt request	CTRLU
RESETX	Master (power up) reset	CTRLU,RFI
DSP1RSTX	Reset for the DSP	DSPU
UIMRESET	Reset for the UIM	UIF
WRX	Write strobe	RFI
RDX	Read strobe	RFI
RFIAD(3:0)	RFI address bus	RFI
SCLK	synthesizer load clock	RF
SDATA	synthesizer load data	RF
SENA1	UHF and VHF PLL enable	RF
RXPWR	RX circuitry power enable	RF
TXPWR	TX circuitry power enable	RF
SYNTHPWR	synthesizer circuitry power enable	RF
TXP	Transmitter power control enable	RF
TXL	Transmitter low power enable	RF
MCUCLK	Main clock for MCU	CTRLU
DSPCLKEN	DSP clock circuit enable	DSPU
RFICLK	RFI master clock	RFI
RFI2CLK	RFI sleep clock	RFI
CODEC_CLK	PCM data clock	DSPU,AUDIO
PCMDATRCLKX	Inverted PCM data clock, used as input clock for Codec and DBUS interface	DSPU
SYNC	Bit sync clock	AUDIO

Signal name	Signal description	To
PCMCOSYCLKX	Bit sync clock, inverted	DSPU
DCLK	DBUS data clock	System conn
DSYNC	DBUS bit sync clock	System conn
DBUSCLK	DBUS data clock	DSPU
DBUSSYNC	DBUS bit sync clock	DSPU
UIMCLK	UIM data clock	UIF
VUIM	UIM power control	UIF
ROMSELX	Chip select for the FLASH memory	CTRLU
EROMSELX	Chip select for the EEPROM memory	CTRLU
BENA	Power supply to headset adapter	System conn
RAMSELX	Chip select for the SRAM memory	CTRLU
ROMAD18	Rom address 18, (paging)	CTRLU
COL(3:0)	Lines for keyboard column write	UIF

External Signals and Connections, Bidirectional

Signal name	Signal description	To/From
DSPDA(15:0)	16–bit data bus	DSPU
MCUDA(7:0)	MCU's 8–bit data bus	CTRLU
RFIDA(11:0)	12–bit data bus	RFI
UIF(6:0)	LCD–controller control and keyboard read bus	UIF
UIMDATA	Serial data to UIM	UIF

Block Description

PSL+ supplies the reset to the ASIC at power up. The ASIC starts the clocks to the DSP and the MCU. After about 20uS the ASIC releases the resets to all circuitry. MCU and RFI reset is released after 256 13 MHz clock cycles. DSP reset release time from DSP clock activation can be selected from 0 to 255 13 MHz clock cycles. In our case 255 is selected. UIM reset release time is according to DCS1900 UIM specifications.

The RFC buffer buffers the 26MHz clock from the VCTCXO to the ASIC. In the ASIC the clock is further buffered and divided for the MCU, RFI, UIM. It also generates main and sync clocks for audio codec, DSP's SIOs and DBUS. The clock outputs can be disabled in order to save current when the clock is not needed. Also the DSP oscillator can be stopped by the ASIC.

Interface to the MCU is done with 8 bit data bus ,5 bit lower address bus, 4 bit upper address bus, RSTRBEX, WSTROBEX, IRQX and NMI. ASIC is in the same memory space as MCU memories. The ASIC generates chip selects from the address bits A16–19. There is also M2BUS detector and netfree counter on the ASIC. Netfree interrupt IRQX occurs if no activity is detected in M2BUS in about 3ms. NMI is used to wake up the MCU from sleep mode.

MCU and DSP communicate through ASIC. ASIC has an MCU mailbox and a DSP mailbox. MCU writes data to DSP mailbox where DSP can only read the incoming data. In MCU mailbox the data transfer direction is the opposite. The size of the mailbox is 64 * 8 bit.

MCU and User Interface (keyboard and display) communication is controlled through the ASIC.

COL(0–3) are used as column lines in keyboard. UIF(0–5) are used as row lines They are also multiplexed with display driver control signals.

When a key is pressed the ASIC gets a reset from row and starts scanning. One column at the time is written to low and rows are used to read which key it was.

Row lines and UIF6 are used for display driver control. UIF(0–3) are used as 4 bit parallel data bus for the LCD driver. UIF4 is used as read/write strobe, UIF5 to select data or instruction register and UIF6 as enable strobe.

The UIM interface is the electrical interface between the smart card used in the DCS1900 applications and the MCU via the ASIC. ASIC converts the serial data received from the UIM to parallel data for MCU and converts parallel data from MCU to serial mode for the card. The UIM interface also takes care of the power up and down procedure to the card, frame and parity error checking. The communication between card and ASIC is asyncronous and half duplex. Four signals are used between the ASIC and the UIM card: UIMDATA, UIMCLK,UIMRESET and VUIM. The clock frequency is 3.25 MHz. When there is no data transfer between the UIM card and the HP the clock can be reduced to 1.625 MHz. Some UIM cards also allows the clock to be stopped in that mode. Supply voltage VUIM can be switched off by the ASIC. The supply voltage is 4.65 V. The carddetect input on the ASIC is connected to BTYPE pin and when the battery is removed the ASIC will drive the UIM down.

The interface to the DSP is done using 6 bit address bus, 16 bit data bus, IOX and RWX lines. Data bus is latched using IOX, address bus is not. The ASIC also generates interrupt INT0 when an edge occurs in DBUS line (if the mask bit is off). INT1 is used as RX interrupt and as MFI modulator interrupt to the DSP.

Viterbi is used to perform GSM/PCN convolutional decoding and bit detection according to viterbi algorithm. It can be controlled and accessed throughly by the DSP.

Coder is used to perform block encoding, decoding, and ciphering according to GSM algorithm A5/1 or A5/2. (ASIC circuit supports both algorithms.)

The ASIC takes care of the interface between the DSP and the RFI: TX modulator, RX filter, TX and RX sample buffers and controlling state machine. The interface to RFI is done using 12 bit data bus, 4 bit address bus, RDX and WRX. There is data acknowledge (DAX) from RFI to ASIC. Also in this block are the serial RF synthesizer interface (SCLK, SDAT) and the digital RF control signals (RXPWR, TXPWR, TXP, SYNTHPWR).

Main Components

D2CA ASIC

RFC buffer

– Inverter buffer stage is used as a buffer for the VCTCXO clock.

RFI

Introduction

The RFI block consists of the RFI ASIC and its reference voltage generator. This block is an interface between the RF and baseband sections. The RFI block has the following functions:

– IF receiving and AD conversion

– I/Q separation

– I– and Q–transmit and DA conversion

– AFC DA

– TXC

– AGC (in combination with TXC)

Technical Specification

External Signals and Connections, Inputs

Signal name	Signal description	From
VL1	Logic supply voltage. Max 150 mA.	PWRU
VA2	Analog supply voltage. Max 80 mA.	PWRU
RESETX	Master (power up) reset	ASIC
RFIAD(3:0)	RFI address bus	ASIC
RDX	Read strobe	ASIC
WRX	Write strobe	ASIC
RFICLK	RFI master clock	ASIC
RFI2CLK	RFI sleep clock	ASIC
RXQ	RX quadrature signal	RF
RXI	RX inphase signal	RF

External Signals and Connections, Outputs

Signal name	Signal description	To
DAX	Data acknowledge	ASIC
AFC	Automatic frequency control voltage	RF
TXC	TX transmit power control voltage, AGC–control	RF

Signal name	Signal description	To
TXQP,TXQN	differential TX quadrature signal	RF
TXIP,TXIN	differential TX inphase signal	RF
PDATA0	front end AGC–data	RF

External Signals and Conections, Bidirectional

Signal name	Signal description	To/From
RFIDA(11:0)	12–bit data bus	ASIC

Block Description

The RFI provides A/D conversion of the in–phase (RXI) and quadrature (RXQ) signals in receive path. It has 12 bit sigma–delta A/D converters and the sample rate is 541.667 kHz.

Analog transmit path includes 8 bit D/A converters to generate the in–phase (TXI) and quadrature (TXQ) signals. RFI has differential outputs for TXI and TXQ. The sample rate is 1.0833 MHz.

There is 11 bit D/A converter for automatic frequency correction. The sample rate is 1.3542 kHz.

Power ramp is done with 10 bit D/A converter. The sample frequency is 1.0833 MHz.

Front end AGC control is done with PDATA0 output. Main part of AGC is controlled by TXC.

The RFI has 12 bit data bus to the ASIC. The registers in the RFI are accessed using 4 address bits. Control and clock signals are coming from the ASIC.

The RFI has external 4.096 V voltage reference.

Main Components

– RFI ASIC

– 4.096 V external voltage reference LM4040 for RFI

Definitions and Abbreviations

UIF .... User Interface module
EAR ... Ear phone
MIC .... Microphone
SIO .... Serial Input/Output
IO ..... Input/Output
DSP ... Digital Signal Prosessor
LCD .... Liquid Crystal Display
MCU ... Micro Controller Unit
UIM .... User Identity Module
MRP ... Mouth Reference Point
HP ..... Hand Portable
HFJ .... Hands Free Junction (box)
LSP .... Loud SPeaker
ASIC ... Application Spesific Integrated Circuit (In this case D2CA ASIC)
VCTCXO Voltage Compensated Temperature Compensated oscillator
RFI .... RFI ASIC
PSL+ ... Power SuppLy IC+
PWM ... Pulse Width Modulation
VAD .... Voice Activity Detection
DTX .... Discontinuous Transmission
AGC ... Automatic Gain Control
AFC .... Automatic Frequency Control
RF ..... Radio Frequency
TDMA .. Time divided multible access
PCM ... Pulse Code Modulation
DTMF .. Dual Tone multi frequency
IF ..... Intermediate Frequency
AD ..... Analog to Digital
DA ..... Digital to Analog
TXI .... In–phase signal
TXQ ... quadrature signal

RF Blocks

Technical Summary

The RF module carries out all the RF functions of the transceiver. This module works in the DCS1900 system .

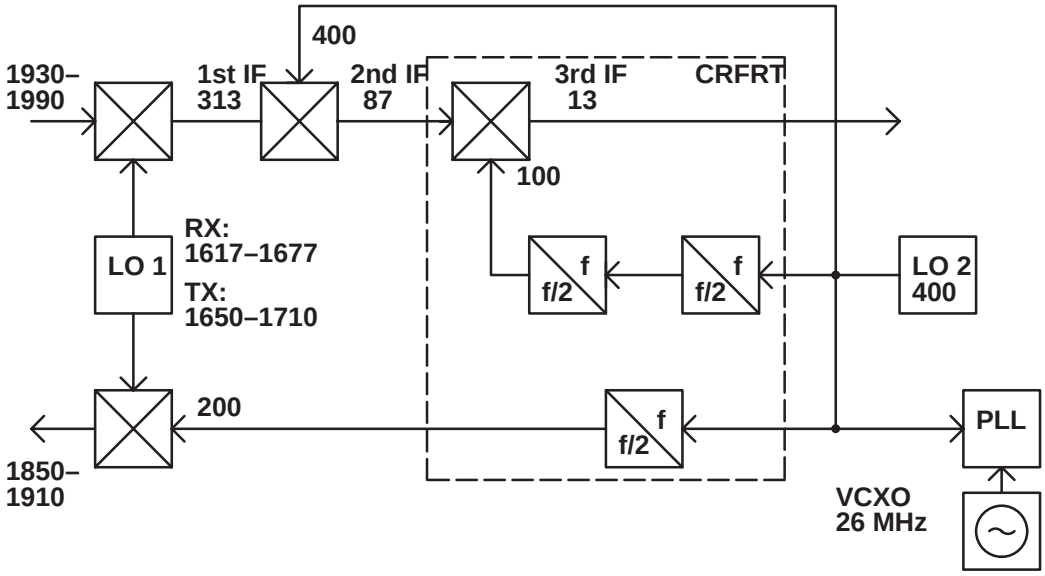
The RF module is constructed on a 1.0 mm thick FR4 six–layer Printed Wire Board.

Components are located on both sides of the PWB. All components with height less than 2 mm are on side one and higher components are on side two.

EMC leakage is prevented with metallized plastic shield A on side one and magnesium shield B on side two. Shield B conducts also heat out of the inner parts of the phone thus preventing excessive temperature rise.

Technical Specification

RF Frequency Plan



Maximum Ratings

The maximum battery voltage during the transmission should not exceed 8.5 V. Higher battery voltages may destroy the power amplifier. This will be quaranteed by hardware based limiting which has maximum value 7.6 ±0.3 V.

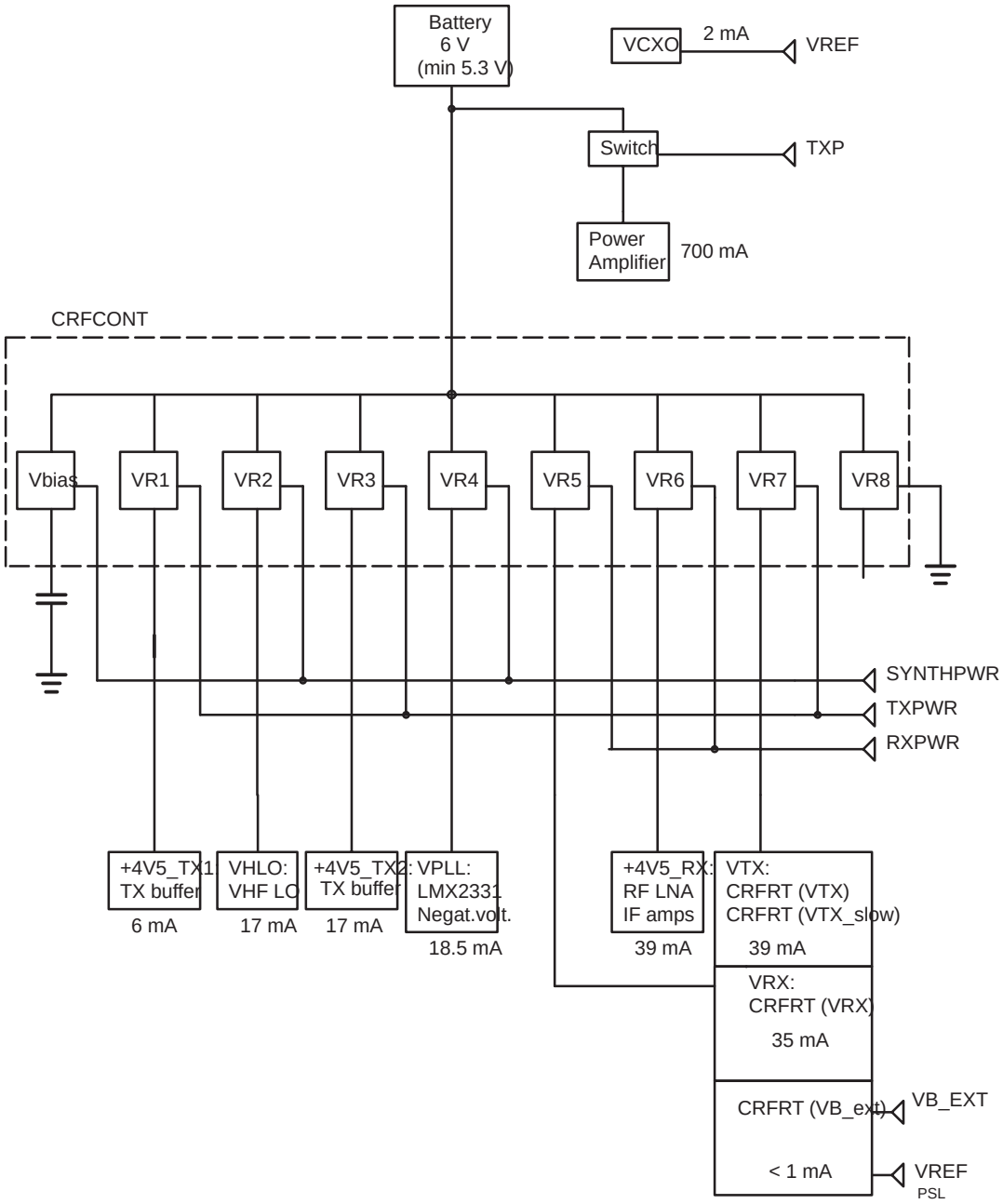
Power Distribution

All currents in the power distribution diagram are peak currents. Activity percentages are in SPEECH–mode 24.6 % for RXPWR , 15.8 % for TXPWR and

100 % for SYNTHPWR. In IDLE–mode activities are 0.4 %, 0.0 % and 1.77 % respectively. The current of each block is controlled independently and for example TXPWR and RXPWR are not on at the same time.

Regulators

There is one regulator IC in the RF unit. The regulator IC CRFCONT is an RF power supply circuit basically intended for digital handportable phones. It has 8 separate linear regulators and power on/off switches for RF–circuitry. Each regulator can be individually disabled and enabled. It also has a voltage reference output.



Functional Description

Receiver

The receiver is a triple conversion receiver.

The received RF signal from the antenna is fed via a duplex filter to the receiver unit. The signal is amplified by a discrete low noise preamplifier. The gain of the amplifier is controlled by the AGC control line (PDATA0). The nominal gain of 14 dB is reduced in the strong field condition about 36 dB. After the preamplifier the signal is filtered by ceramic filter. The filter rejects spurious signals coming from the antenna and spurious emissions coming from the receiver unit.

The filtered RF– signal is down converted by a passive diode mixer. The frequency of the first IF is 313 MHz. The first local signal is generated by the UHF synthesizer. The IF signal is amplified and then it is filtered by a microstripline filter. The filtered 1st IF is down converted by the second mixer which is also a passive diode mixer. The 2nd IF frequency is 87 MHz. The 2nd local signal is generated by the VHF synthesizer.

The IF signal 87 MHz is amplified and filtered by SAW filter. The filter rejects adjacent channel signal, intermodulating signals and the last IF image signal.

The filtered IF signal is fed to the receiver part of the integrated RF circuit CRFRT. In CRFRT the filtered IF signal is amplified by an AGC amplifier which has gain control range of 57 dB. The gain is controlled by an analog signal via TXC–line. The amplified IF signal is down converted to the last IF in the mixer of CRFRT. The last local signal is generated from VHF VCO by dividing the original signal by 4 in the dividers of CRFRT.

The last IF frequency is 13 MHz.

The last IF is filtered by a ceramic filter. The filter rejects signals of the adjacent channels. The filtered last IF is fed back to CRFRT where it is amplified and fed out to RFI via RXI–line.

Frequency Synthesizers

The stable frequency source for the synthesizers and base band circuits is discrete voltage controlled crystal oscillator, VCXO. The frequency of the oscillators is controlled by an AFC voltage, which is generated by the base band circuits.

The UHF PLL generates the down conversion signal for the receiver and the up conversion signal for the transmitter. The UHF VCO is a discrete oscillator. PLL circuit is from National: LMX2331ATM.

The VHF PLL signal (divided by 4 in CRFRT) is used as a local for the last mixer. Directly it is used as a second local in PCN. Also the VHF PLL signal (divided by 2 in CRFRT) is used in the I/Q modulator of the transmitter chain.

Transmitter

The TX intermediate frequency is modulated by an I/Q modulator contained on transmitter section of CRFRT IC. The TX I and Q signals are generated in the RFI interface circuit and they are fed differentially to the modulator.

Modulated intermediate signal is amplified or attenuated in temperature compensated controlled gain amplifier (TCGA). The output of the TCGA is amplified and the output level is typically –10dBm.

The output signal from CRFRT is low–pass filtered to reduce harmonics and the final TX signal is achieved by mixing the UHF VCO signal and the modulated TX intermediate signal with passive mixer. After mixing the TX signal is amplified and filtered by two amplifiers and filters. These filters are dielectric filters. After these stages the level of the signal is typically 1 mW (0 dBm).

The discrete power amplifier amplifies the TX signal to the desired power level. The maximum output level is typically 0.8 ... 1.0 W.

The power control loop controls the output level of the power amplifier. The power detector consists of a directional coupler and a diode rectifier. Transmitted power is controlled with controlled gain amplifier (TCGA) on TX–path of CRFRT. Power is controlled with TXC and TXP signals. The power control signal (TXC), which has a raised cosine form, comes from the RF interface circuit, RFI.

RF Characteristics

Duplex Filter

The duplex filter consists of two functional parts; RX and TX filters. The TX filter rejects the noise power at the RX frequency band and TX harmonic signals. The RX filter rejects blocking and spurious signals coming from the antenna.

Pre–amplifier

The bipolar pre–amplifier amplifies the received signal coming from the antenna. In the strong field conditions the gain of the amplifier is reduced 39 dB, typically.

RX Interstage Filter

The RX interstage filter is a three pole ceramic filter. The filter rejects spurious and blocking signals coming from the antenna. It rejects the local oscillator signal leakage, too.

First Mixer

The first mixer is a single balanced passive diode mixer. The local signal is balanced by a printed circuit transformer. The mixer down converts the received RF signal to IF signal.

First IF Amplifier

The first IF amplifier is a bipolar transistor amplifier.

First IF Filter

The first IF filter is a microstripline filter. The IF filter rejects some spurious and blocking signal coming from the front end of the receiver.

2nd Mixer

The 2nd mixer is a single balanced passive diode mixer. The local signal is balanced by a printed circuit transformer. The mixer down converts the 1st IF signal 313 MHz to 2nd IF signal 87 MHz.

2nd IF Amplifier

The 2nd IF amplifier consists of two bipolar transistors. The bias current is ON only during the reception.

2nd IF Filter

The second IF filter (SAW) makes the part of the channel selectivity of the receiver. It rejects adjacent channel signals (except the 2nd adjacent). It also rejects blocking signals and the 3rd image frequency.

Receiver IF circuit, RX part of CRFRT

The receiver part of CRFRT consists of an AGC amplifier of 57 dB gain, a mixer and a buffer amplifier for the last IF. The mixer of the circuit down converts the received signal to the last IF frequency. After external filtering the signal is amplified and fed to baseband circuitry. The supply current can be switched OFF by an internal switch, when the RX is OFF.

Last IF Filter

The last IF is a ceramic filter, which makes the part of the channel selectivity of the receiver.

TRANSMITTER

Modulator Circuit, TX part of CRFRT

The modulator is a quadrature modulator contained in Tx–section of CRFRT IC. The I– and Q– inputs generated by RFI interface are DC–coupled and fed via buffers to the modulator. The local signal is divided by two to get accurate 90 degrees phase shifted signals to the I/Q mixers. After mixing the signals are combined and amplified with temperature compensated controlled gain amplifier (TCGA). Gain is controlled with power control signal (TXC). The output of the TCGA is amplified and the maximum output level is –10 dBm, typically.

Upconversion mixer

The upconversion mixer is a single balanced passive diode mixer. The local signal is balanced by a printed circuit transformer. The mixer upconverts the modulated IF signal coming from quadrature modulator to RF signal.

TX Interstage Filters

The TX filters reject the spurious signals generated in the upconversion mixer. They reject the local, image and IF signal leakage and RX band noise, too.

1st TX Buffer

The TX buffer is a bipolar transistor amplifier. It amplifies the TX signal coming from the upconversion mixer.

2nd TX Buffer

The TX buffer is a bipolar transistor amplifier. It amplifies the TX signal coming from the first interstage filter.

3rd TX Buffer

The TX buffer is a bipolar transistor amplifier. It amplifies the TX signal coming from the second interstage filter.

Power Amplifier

The power amplifier is a two stage discrete amplifier. It amplifies the 13 dBm TX signal to the desired output level. It has been specified for 6 volts operation.

Power Control Circuitry

The power control loop consists of a power detector and a differential control circuit. The power detector is a combination of a directional coupler and a diode rectifier. The differential control circuit compares the detected voltage

and the control voltage (TXC) and controls voltage controlled amplifier (in CRFRT) and the power amplifier. The control circuit is a part of CRFRT.

SYNTHESIZER

Reference Oscillator

The reference oscillator is a discrete VCXO and the frequency is 26 MHz.

The oscillator signal is used for a reference frequency of the synthesizers and the clock frequency for the base band circuits.

VHF PLL

The VHF PLL consists of the VHF VCO, PLL integrated circuit and loop filter. The output signal is used for the 3rd mixer of the receiver and for the I/Q modulator of the transmitter.

VHF VCO + Buffer

The VHF VCO uses a bipolar transistor as a active element and a combination of a chip coil and varactor diode as a resonance circuit. The buffer is combined into the VCO circuit so, that they use same collector current.

UHF PLL

The UHF PLL consists of a UHF VCO, divider, PLL circuit and a loop filter. The output signal is used for the 1st mixer of the receiver and the upconversion mixer of the transmitter. In PCN the VCO change the frequency according to the RX/TX mode change.

UHF VCO + Buffer

The UHF VCO uses a bipolar transistor as a active element and a combination of a microstripline and a varactor diode as a resonance circuit.

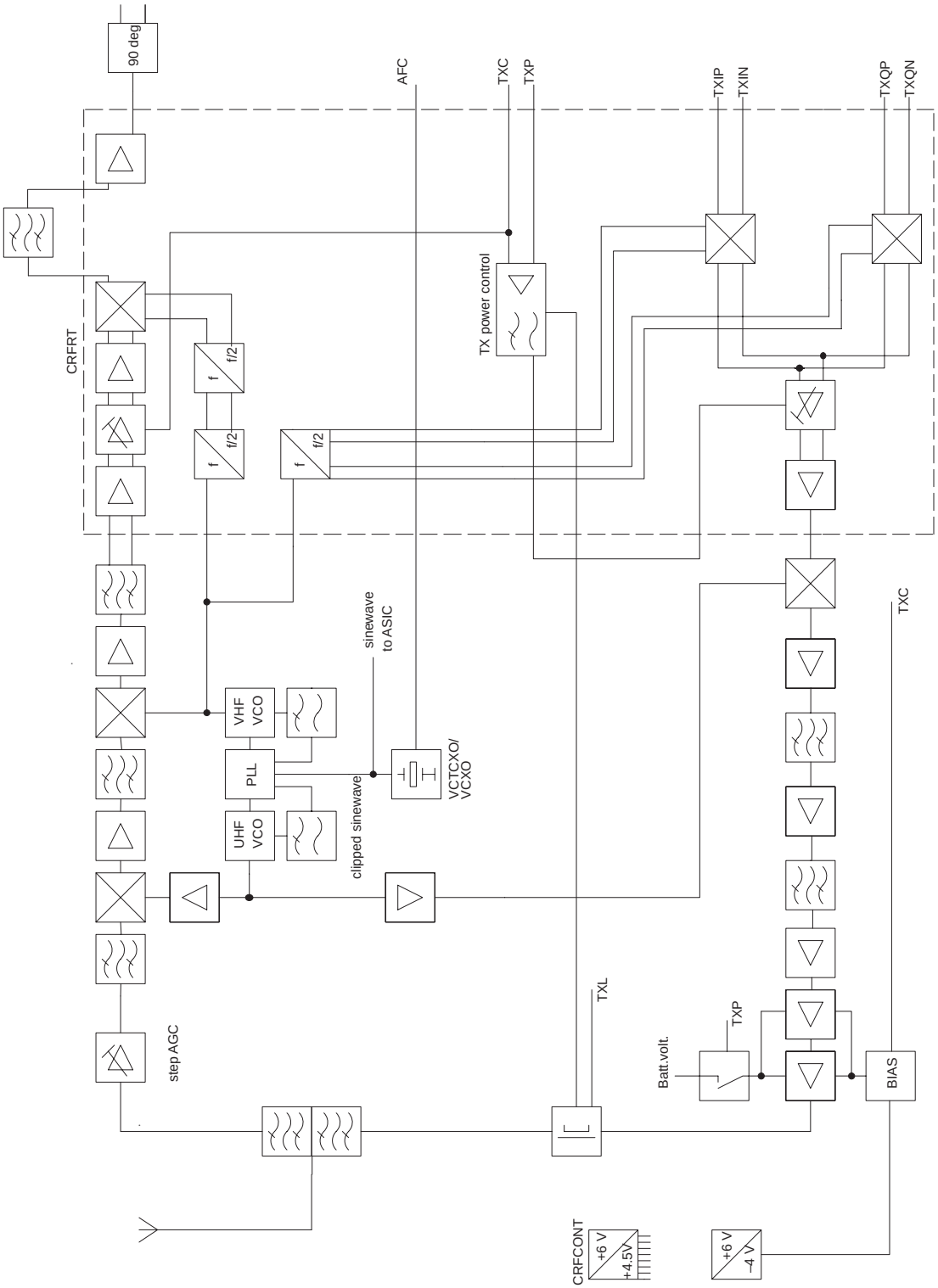
UHF VCO Buffers

The buffers amplifies the UHF VCO signal. The output signal is divided into the 1st mixer of the receiver and the upconversion mixer of the transmitter. There is one buffer for TX and one for RX.

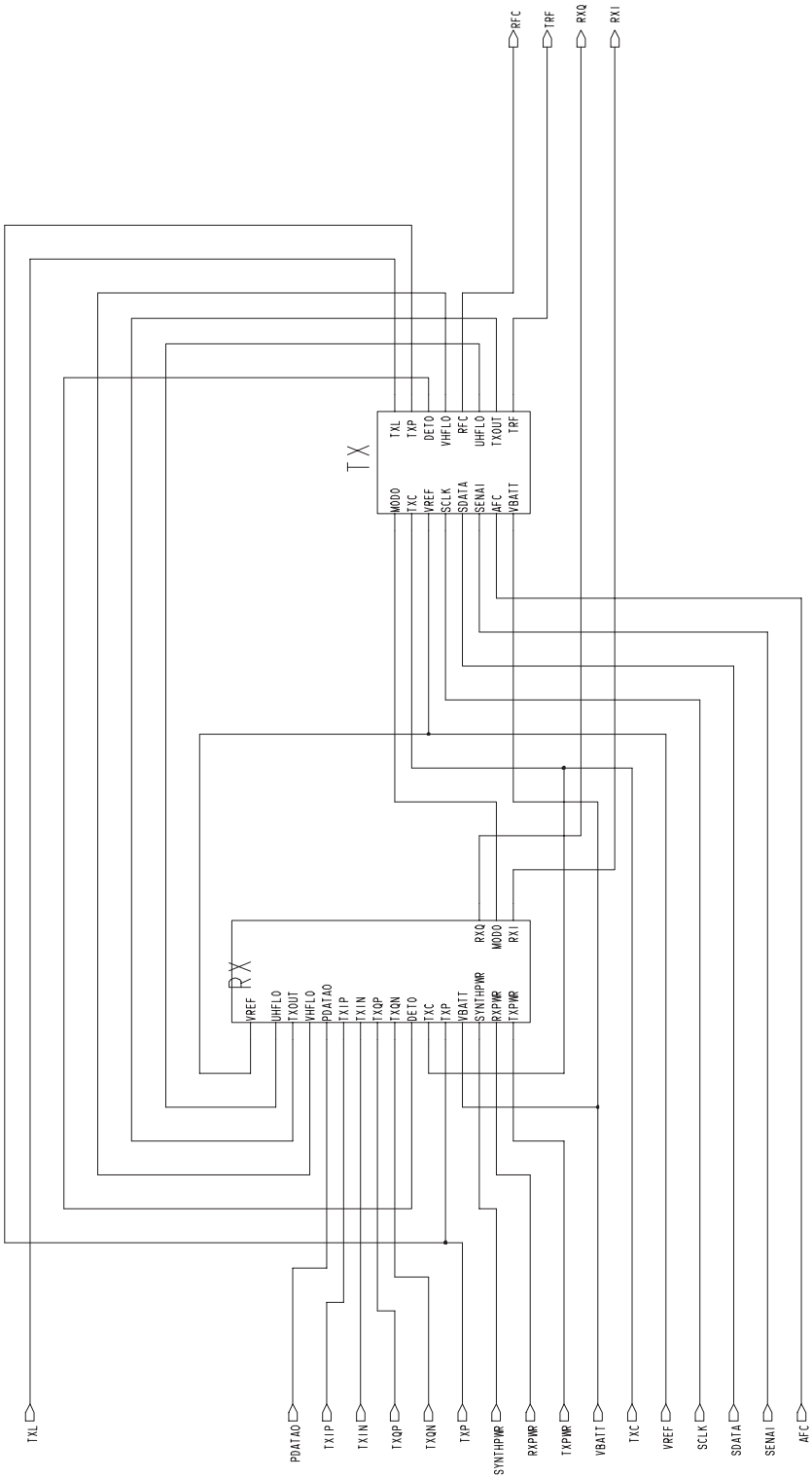
PLL Circuit

The PLL is NATIONAL LMX2331ATM. The circuit is a dual frequency synthesizer including both the UHF and VHF synthesizers.

Block Diagram of Receiver Section



Connections between RX and TX (Version: 6.0 Edit: 88)



Block Diagram

Block Diagram of System Section

Circuit Diagram of CTRLU Section

Circuit Diagram of PWRU Section

Circuit Diagram of DSPU Section

Circuit Diagram of Audio Section

Circuit Diagram of ASIC Section

Circuit Diagram of RFI Section

Circuit Diagram of Receiver Section

Circuit Diagram of Transmitter Section

Layout Diagram of DB6 side 1

Layout Diagram of DB6 side 2

Parts List of DB6 (EDMS Issue: 3.2)

ITEM	CODE	DESCRIPTION	VALUE	TYPE
R040	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R070	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R071	1430794	Chip resistor	39 k	5 % 0.063 W 0402
R072	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R073	1430764	Chip resistor	3.3 k	5 % 0.063 W 0402
R074	1430730	Chip resistor	150	5 % 0.063 W 0402
R075	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R076	1430744	Chip resistor	470	5 % 0.063 W 0402
R077	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R078	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R079	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R110	1430842	Chip resistor	680 k	1 % 0.063 W 0402
R111	1430840	Chip resistor	220 k	1 % 0.063 W 0402
R112	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R113	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R114	1430732	Chip resistor	180	5 % 0.063 W 0402
R140	1430792	Chip resistor	33 k	5 % 0.063 W 0402
R141	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R142	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R143	1430764	Chip resistor	3.3 k	5 % 0.063 W 0402
R144	1430764	Chip resistor	3.3 k	5 % 0.063 W 0402
R145	1430732	Chip resistor	180	5 % 0.063 W 0402
R146	1430846	Chip resistor	2.7 k	1 % 0.063 W 0402
R147	1430844	Chip resistor	3.9 k	1 % 0.063 W 0402
R148	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R149	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R150	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R151	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R152	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R160	1430726	Chip resistor	100	5 % 0.063 W 0402
R161	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R162	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R163	1430726	Chip resistor	100	5 % 0.063 W 0402
R164	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R165	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R166	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R169	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R170	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R171	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R172	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R173	1430794	Chip resistor	39 k	5 % 0.063 W 0402
R174	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R175	1430700	Chip resistor	10	5 % 0.063 W 0402

R176	1430726	Chip resistor	100	5 % 0.063 W 0402
R177	1430726	Chip resistor	100	5 % 0.063 W 0402
R178	1430726	Chip resistor	100	5 % 0.063 W 0402
R179	1430726	Chip resistor	100	5 % 0.063 W 0402
R180	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R181	1430726	Chip resistor	100	5 % 0.063 W 0402
R182	1430726	Chip resistor	100	5 % 0.063 W 0402
R183	1430734	Chip resistor	220	5 % 0.063 W 0402
R184	1430726	Chip resistor	100	5 % 0.063 W 0402
R185	1430726	Chip resistor	100	5 % 0.063 W 0402
R186	1430726	Chip resistor	100	5 % 0.063 W 0402
R190	1430726	Chip resistor	100	5 % 0.063 W 0402
R191	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R192	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R193	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R194	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R195	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R196	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R197	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R198	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R199	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R210	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R230	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R231	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R232	1430842	Chip resistor	680 k	1 % 0.063 W 0402
R233	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R234	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R235	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R236	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R237	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R238	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R239	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R240	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R241	1430744	Chip resistor	470	5 % 0.063 W 0402
R245	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R246	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R247	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R248	1430726	Chip resistor	100	5 % 0.063 W 0402
R249	1430726	Chip resistor	100	5 % 0.063 W 0402
R250	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R251	1430792	Chip resistor	33 k	5 % 0.063 W 0402
R252	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R253	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R254	1430760	Chip resistor	1.8 k	5 % 0.063 W 0402
R255	1430726	Chip resistor	100	5 % 0.063 W 0402
R256	1430726	Chip resistor	100	5 % 0.063 W 0402
R257	1430718	Chip resistor	47	5 % 0.063 W 0402
R260	1430726	Chip resistor	100	5 % 0.063 W 0402

R261	1430784	Chip resistor	15 k	5 % 0.063 W 0402
R262	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R263	1430760	Chip resistor	1.8 k	5 % 0.063 W 0402
R264	1430792	Chip resistor	33 k	5 % 0.063 W 0402
R265	1430792	Chip resistor	33 k	5 % 0.063 W 0402
R267	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R270	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R501	1430784	Chip resistor	15 k	5 % 0.063 W 0402
R502	1430722	Chip resistor	68	5 % 0.063 W 0402
R503	1430740	Chip resistor	330	5 % 0.063 W 0402
R504	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R505	1430772	Chip resistor	5.6 k	5 % 0.063 W 0402
R506	1430710	Chip resistor	22	5 % 0.063 W 0402
R507	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R508	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R509	1430774	Chip resistor	68	5 % 0.063 W 0402
R510	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R511	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R512	1430832	Chip resistor	2.7 k	5 % 0.063 W 0402
R513	1430740	Chip resistor	330	5 % 0.063 W 0402
R514	1430710	Chip resistor	22	5 % 0.063 W 0402
R515	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R516	1430726	Chip resistor	100	5 % 0.063 W 0402
R517	1430722	Chip resistor	68	5 % 0.063 W 0402
R521	1430744	Chip resistor	470	5 % 0.063 W 0402
R522	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R523	1430764	Chip resistor	3.3 k	5 % 0.063 W 0402
R524	1430734	Chip resistor	220	5 % 0.063 W 0402
R525	1430734	Chip resistor	220	5 % 0.063 W 0402
R531	1430710	Chip resistor	22	5 % 0.063 W 0402
R532	1430740	Chip resistor	330	5 % 0.063 W 0402
R533	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R534	1430832	Chip resistor	2.7 k	5 % 0.063 W 0402
R535	1430710	Chip resistor	22	5 % 0.063 W 0402
R541	1430710	Chip resistor	22	5 % 0.063 W 0402
R543	1430740	Chip resistor	330	5 % 0.063 W 0402
R544	1430764	Chip resistor	3.3 k	5 % 0.063 W 0402
R545	1430764	Chip resistor	3.3 k	5 % 0.063 W 0402
R546	1430722	Chip resistor	68	5 % 0.063 W 0402
R547	1430744	Chip resistor	470	5 % 0.063 W 0402
R548	1430734	Chip resistor	220	5 % 0.063 W 0402
R549	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R550	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R551	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R552	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R553	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R554	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R555	1430788	Chip resistor	22 k	5 % 0.063 W 0402

R556	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R557	1430730	Chip resistor	150	5 % 0.063 W 0402
R558	1430732	Chip resistor	180	5 % 0.063 W 0402
R559	1430740	Chip resistor	330	5 % 0.063 W 0402
R560	1430764	Chip resistor	3.3 k	5 % 0.063 W 0402
R561	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R562	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R563	1430728	Chip resistor	120	5 % 0.063 W 0402
R564	1430738	Chip resistor	270	5 % 0.063 W 0402
R565	1430748	Chip resistor	680	5 % 0.063 W 0402
R566	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R567	1430728	Chip resistor	120	5 % 0.063 W 0402
R568	1430734	Chip resistor	220	5 % 0.063 W 0402
R569	1430748	Chip resistor	680	5 % 0.063 W 0402
R570	1430726	Chip resistor	100	5 % 0.063 W 0402
R571	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R572	1430276	Chip resistor	47 k	2 % 0.063 W 0603
R573	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R574	1430734	Chip resistor	220	5 % 0.063 W 0402
R576	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R577	1430792	Chip resistor	33 k	5 % 0.063 W 0402
R578	1430794	Chip resistor	39 k	5 % 0.063 W 0402
R579	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R580	1430790	Chip resistor	27 k	5 % 0.063 W 0402
R584	1430310	Chip resistor	75 k	2 % 0.063 W 0603
R585	1430762	Chip resistor	2.2 k	5 % 0.063 W 0603
R586	1430762	Chip resistor	2.2 k	5 % 0.063 W 0603
R601	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R602	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R603	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R701	1430832	Chip resistor	2.7 k	5 % 0.063 W 0402
R702	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R703	1430710	Chip resistor	22	5 % 0.063 W 0402
R704	1430740	Chip resistor	330	5 % 0.063 W 0402
R705	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R710	1430710	Chip resistor	22	5 % 0.063 W 0402
R712	1430786	Chip resistor	18 k	5 % 0.063 W 0402
R713	1430744	Chip resistor	470	5 % 0.063 W 0402
R714	1430718	Chip resistor	47	5 % 0.063 W 0402
R715	1430734	Chip resistor	220	5 % 0.063 W 0402
R727	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R728	1430726	Chip resistor	100	5 % 0.063 W 0402
R729	1430730	Chip resistor	150	5 % 0.063 W 0402
R737	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R738	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R739	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R740	1430774	Chip resistor	6.8 k	5 % 0.063 W 0402
R741	1430764	Chip resistor	3.3 k	5 % 0.063 W 0402

R742	1430774	Chip resistor	6.8 k	5 % 0.063 W 0402
R743	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R744	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R745	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R747	1430710	Chip resistor	22	5 % 0.063 W 0402
R748	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R749	1430740	Chip resistor	330	5 % 0.063 W 0402
R750	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R751	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R755	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R756	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R757	1430730	Chip resistor	150	5 % 0.063 W 0402
R758	1412279	Chip resistor	2.2	5 % 0.1 W 0805
R765	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R766	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R767	1430728	Chip resistor	120	5 % 0.063 W 0402
R768	1420200	Chip resistor	0.22	5 % 0.2 W 1206
R780	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R781	1430726	Chip resistor	100	5 % 0.063 W 0402
R782	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R783	1430744	Chip resistor	470	5 % 0.063 W 0402
R784	1430726	Chip resistor	100	5 % 0.063 W 0402
R785	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R790	1430700	Chip resistor	10	5 % 0.063 W 0402
R791	1430718	Chip resistor	47	5 % 0.063 W 0402
R792	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R800	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R801	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R802	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R803	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R804	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R805	1430786	Chip resistor	18 k	5 % 0.063 W 0402
R806	1430774	Chip resistor	6.8 k	5 % 0.063 W 0402
R807	1430760	Chip resistor	1.8 k	5 % 0.063 W 0402
R808	1430734	Chip resistor	220	5 % 0.063 W 0402
R809	1820024	NTC resistor	47 k	5 % 0.2 W 0805
R811	1430764	Chip resistor	3 k	5 % 0.063 W 0402
R820	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R821	1430786	Chip resistor	18 k	5 % 0.063 W 0402
R822	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R823	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R824	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R825	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R827	1430844	Chip resistor	3.9 k	1 % 0.063 W 0402
R828	1430786	Chip resistor	18 k	5 % 0.063 W 0402
R829	1430718	Chip resistor	47	5 % 0.063 W 0402
R830	1430718	Chip resistor	47	5 % 0.063 W 0402
R840	1430786	Chip resistor	18 k	5 % 0.063 W 0402

R841	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R842	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R843	1430832	Chip resistor	2.7 k	5 % 0.063 W 0402
R844	1430734	Chip resistor	220	5 % 0.063 W 0402
R845	1430700	Chip resistor	10	5 % 0.063 W 0402
R846	1430710	Chip resistor	22	5 % 0.063 W 0402
R847	1430718	Chip resistor	47	5 % 0.063 W 0402
C040	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C041	2320544	Ceramic cap.	22 p	5% 50 V 0402
C109	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C110	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C111	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C112	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C113	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C114	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C115	2611668	Tantalum cap.	4.7 µ	20 % 10 V 3.2x1.6x1.6
C116	2611668	Tantalum cap.	4.7 µ	20 % 10 V 3.2x1.6x1.6
C117	2611668	Tantalum cap.	4.7 µ	20 % 10 V 3.2x1.6x1.6
C118	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C119	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C120	2611668	Tantalum cap.	4.7 µ	20 % 10 V 3.2x1.6x1.6
C121	2611668	Tantalum cap.	4.7 µ	20 % 10 V 3.2x1.6x1.6
C122	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C123	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C124	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C125	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C126	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C127	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C140	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C141	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C142	2320598	Ceramic cap.	3.9 n	5 % 50 V 0402
C160	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C170	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C171	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C172	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C173	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C175	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C176	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C177	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C178	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C180	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C181	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C182	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C183	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C185	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C186	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C187	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C188	2320560	Ceramic cap.	100 p	5 % 50 V 0402

C195	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C196	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C197	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C198	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C200	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C201	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C202	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C203	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C210	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C211	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C220	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C221	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C230	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C231	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C232	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C233	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C234	2320598	Ceramic cap.	3.9 n	5 % 50 V 0402
C235	2320598	Ceramic cap.	3.9 n	5 % 50 V 0402
C236	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C237	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C239	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C240	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C241	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C250	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C251	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C252	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C253	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C254	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C255	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C256	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C257	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C258	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C259	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C260	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C261	2320110	Ceramic cap.	10 n	10 % 50 V 0603
C262	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C263	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C264	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C265	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C266	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C267	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C268	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C269	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C270	2610100	Tantalum cap.	1 µ	20 % 10 V 2.0x1.3x1.2
C271	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C272	2610100	Tantalum cap.	1 µ	20 % 10 V 2.0x1.3x1.2
C276	2610100	Tantalum cap.	1 µ	20 % 10 V 2.0x1.3x1.2
C277	2310791	Ceramic cap.	33 n	20 % 50 V 0805

C278	2610100	Tantalum cap.	1 µ	20 % 10 V 2.0x1.3x1.2
C279	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C280	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C282	2610100	Tantalum cap.	1 µ	20 % 10 V 2.0x1.3x1.2
C283	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C286	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C287	2610100	Tantalum cap.	1 µ	20 % 10 V 2.0x1.3x1.2
C290	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C291	2610100	Tantalum cap.	1 µ	20 % 10 V 2.0x1.3x1.2
C296	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C500	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C501	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C502	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C503	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C504	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C505	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C506	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C507	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C508	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C509	2320544	Ceramic cap	22 p	5% 50 V 0402
C510	2320544	Ceramic cap	22 p	5% 50 V 0402
C511	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C512	2320516	Ceramic cap.	1.5 p	0.25 % 50 V 0402
C513	2320516	Ceramic cap.	1.5 p	0.25 % 50 V 0402
C514	2320516	Ceramic cap.	1.5 p	0.25 % 50 V 0402
C515	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C516	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C517	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C521	2320530	Ceramic cap.	5.6 p	0.25 % 50 V 0402
C522	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C523	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C524	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C525	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C526	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C527	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C528	2320602	Ceramic cap.	4.7 p	0.25 % 50 V 0402
C531	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C532	2320538	Ceramic cap.	12 p	5 % 50 V 0402
C533	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C534	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C535	2320530	Ceramic cap.	5.6 p	0.25 % 50 V 0402
C536	2320554	Ceramic cap.	56 p	5 % 50 V 0402
C541	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C542	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C543	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C544	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C545	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C546	2320560	Ceramic cap.	100 p	5 % 50 V 0402

C547	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C551	2320534	Ceramic cap.	8.2 p	0.25 % 50 V 0402
C552	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C553	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C554	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C555	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C557	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C558	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C559	2320752	Ceramic cap.	2.2 n	10 % 50 V 0402
C560	2320752	Ceramic cap.	2.2 n	10 % 50 V 0402
C561	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C562	2320075	Ceramic cap.	470 p	5 % 50 V 0603
C563	2320578	Ceramic cap.	560 p	5 % 50 V 0402
C564	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C565	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C566	2320558	Ceramic cap.	82 p	5 % 50 V 0402
C567	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C569	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C570	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C571	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C572	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C573	2320564	Ceramic cap.	150 p	5 % 50 V 0402
C574	2320728	Ceramic cap.	220 p	10 % 50 V 0402
C575	2320530	Ceramic cap.	5.6 p	0.25 % 50 V 0402
C580	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C601	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C602	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C603	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C604	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C605	2312410	Ceramic cap.	1.0 µ	10 % 16 V 1206
C607	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C608	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C609	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C610	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C701	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C702	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C703	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C704	2320516	Ceramic cap.	1.5 p	0.25 % 50 V 0402
C705	2320514	Ceramic cap.	1.2 p	0.25 % 50 V 0402
C710	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C711	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C712	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C714	2320530	Ceramic cap.	5.6 p	0.25 % 50 V 0402
C715	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C717	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C720	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C721	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C725	2320544	Ceramic cap.	22 p	5 % 50 V 0402

C726	2320516	Ceramic cap.	1.5 p	0.25 % 50 V 0402
C729	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C730	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C731	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C735	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C736	2320522	Ceramic cap.	2.7 p	0.25 % 50 V 0402
C739	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C740	2320522	Ceramic cap.	2.7 p	0.25 % 50 V 0402
C741	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C755	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C756	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C758	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C759	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C760	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C761	2320516	Ceramic cap.	1.5 p	0.25 % 50 V 0402
C763	2500708	Electrol. cap.	3300 µ	20 % 16 V
C765	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C766	2320518	Ceramic cap.	1.8 p	0.25 % 50 V 0402
C767	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C768	2320554	Ceramic cap.	56 p	5 % 50 V 0402
C769	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C770	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C771	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C772	2320524	Ceramic cap.	3.3 p	0.25 % 50 V 0402
C774	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C775	2320518	Ceramic cap.	1.8 p	0.25 % 50 V 0402
C776	2320508	Ceramic cap.	1.0 p	0.25 % 50 V 0402
C780	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C781	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C782	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C783	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C784	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C790	2610200	Tantalum cap.	2.2 µ	20 % 2.0x1.3x1.2
C791	2610200	Tantalum cap.	2.2 µ	20 % 2.0x1.3x1.2
C792	2610200	Tantalum cap.	2.2 µ	20 % 2.0x1.3x1.2
C793	2610200	Tantalum cap.	2.2 µ	20 % 2.0x1.3x1.2
C794	2610200	Tantalum cap.	2.2 u	20 % 2.0x1.3x1.2
C795	2610100	Tantalum cap.	1 µ	20 % 10 V 2.0x1.3x1.2
C800	2604079	Tantalum cap.	0.22 µ	20 % 35 V 3.2x1.6x1.6
C801	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C803	2320568	Ceramic cap.	220 p	5 % 50 V 0402
C804	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C805	2320728	Ceramic cap.	220 p	10 % 50 V 0402
C806	2610100	Tantalum cap.	1 µ	20 % 10 V 2.0x1.3x1.2
C807	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C808	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C809	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C810	2320728	Ceramic cap.	220 p	10 % 50 V 0402

C820	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C821	2310248	Ceramic cap.	4.7 n	5 % 50 V 1206
C822	2320466	Ceramic cap.	220 p	5 % 50 V 0603
C823	2310248	Ceramic cap.	4.7 n	5 % 50 V 1206
C824	2320564	Ceramic cap.	150 p	5 % 50 V 0402
C828	2610100	Tantalum cap.	1 µ	20 % 10 V 2.0x1.3x1.2
C829	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C830	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C831	2610100	Tantalum cap.	1 µ	20 % 10 V 2.0x1.3x1.2
C832	2320756	Ceramic cap.	3.3 n	10 % 50 V 0402
C840	2320530	Ceramic cap.	5.6 p	0.25 % 50 V 0402
C841	2610100	Tantalum cap.	1 µ	20 % 10 V 2.0x1.3x1.2
C842	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C843	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C844	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C845	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C846	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C847	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C848	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C849	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C850	2320534	Ceramic cap.	8.2 p	0.25 % 50 V 0402
C851	2320534	Ceramic cap.	8.2 p	0.25 % 50 V 0402
C862	2320522	Ceramic cap.	2.7 p	0.25 % 50 V 0402
C864	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C865	2320560	Ceramic cap.	100 p	5 % 50 V 0402
L040	3606946	Ferrite bead 0.2r 26r/100mhz 1206		
L140	3606946	Ferrite bead 0.2r 26r/100mhz 1206		1206
L180	3606946	Ferrite bead 0.2r 26r/100mhz 1206		1206
L270	3641262	Ferrite bead 30r/100mhz 2a 1206		1206
L271	3641262	Ferrite bead 30r/100mhz 2a 1206		1206
L272	3606946	Ferrite bead 0.2r 26r/100mhz 1206		1206
L273	3606946	Ferrite bead 0.2r 26r/100mhz 1206		1206
L511	3641546	Chip coil	82 n	10 % Q=40 0805
L531	3608414	Chip coil	560 n	10% 1206
L532	3641560	Chip coil	220 n	10 % Q=30/100 MHz
L541	3641550	Chip coil	120 n	10 % Q=35 0805
L542	3608238	Chip coil	180 n	10 % 1206
L543	3608319	Chip coil	270 n	10 % 1206
L544	3608319	Chip coil	270 n	10 % 1206
L545	3608238	Chip coil	180 n	10 % 1206
L551	3641522	Chip coil	6 n	20 % Q=50 0805
L700	3606946	Ferrite bead		0.2r 26r/100 MHz 1206
L710	3641538	Chip coil	39 n	20 % Q=40 0805
L800	3641206	Chip coil		10 % Q=25/7.96 MHz
L801	3641206	Chip coil		10 % Q=25/7.96 MHz
L840	3641572	Chip coil	22 n	5 % Q=45 0805
L841	3641522	Chip coil	6 n	20 % Q=50 0805
B800	4510071	Crystal	26.000 M	

G001	4350017	SM, vco	1617/1710 MHz	4.5 V/10 mA 13x11
Z500	4512055	SM, dupl.1850–1910/1930–1990 MHz		
Z505	4510035	SM, ceramic filter	1960±30 MHz	10x8x3.9
Z541	4511028	SM, SAW IF filter	87MHz±120 kHz	PCN
Z551	4510009	SM, cer.bpf	13 MHz±90 kHz/1 dB	330 R
Z713	4510037	SM, ceramic filter	1880±30 MHz	10x8x3.9
Z727	4510037	SM, ceramic filter	1880±30 MHz	10x8x3.9
V110	4210020	Transistor	BCP69–25	pnp 20 V 2 A SOT223
V111	4200877	Transistor	BCX51–16	pnp 45 V 1.5 A SOT89
V141	4113828	Trans. supr.		28 V 28 A 600 W
V142	4210020	Transistor	BCP69–25	pnp 20 V 2 A SOT223
V143	4200226	Darl. transistor	BCV27	npn 30 V 300 mA SOT23
V144	4200226	Darl. transistor	BCV27	npn 30 V 300 mA SOT23
V145	4200909	Transistor	BC858B/BCW30	pnp 30 V 100 mA SOT23
V147	4110126	Zener diode	BZX84	5 % 4.3 V 0.3 W SOT23
V148	4110074	Schottky diode	STPS340U	40 V 3 A SOD6
V160	4210100	Transistor	BC848W	npn 30 V SOT323
V161	4210100	Transistor	BC848W	npn 30 V SOT323
V210	4110014	Sch. diode x 2	BAS70–07	70 V 15 mA SOT143
V250	4210100	Transistor	BC848W	npn 30 V SOT323
V251	4200909	Transistor	BC858B/BCW30	pnp 30 V 100 mA SOT23
V252	4210102	Transistor	BC858W	pnp 30 V 100 mA 200MW
V253	4110014	Sch. diode x 2	BAS70–07	70 V 15 mA SOT143
V254	4210050	Transistor	DTA114EE	pnp RB V EM3
V270	4117998	Precision voltage reference 4.096		
V501	4210015	Transistor	BFP405	npn 4. V SOT343
V502	4210102	Transistor	BC858W	pnp 30 V 100 mA 200MW
V503	4210100	Transistor	BC848W	npn 30 V SOT323
V504	4210066	Transistor	BFR93AW	npn 12 V 35 mA SOT323
V511	4115802	Sch. diode x 2	4V	30 mA SOT23
V512	4210046	Transistor	BFP182	npn 20 V 35 mA SOT143
V521	4210066	Transistor	BFR93AW	npn 12 V 35 mA SOT323
V531	4100567	Sch. diode x 2	BAS70–04	70V15 mA SERSOT23
V532	4210066	Transistor	BFR93AW	npn 12 V 35 mA SOT323
V541	4210066	Transistor	BFR93AW	npn 12 V 35 mA SOT323
V701	4210046	Transistor	BFP182	npn 20 V 35 mA SOT143
V702	4115802	Sch. diode x 2	4V	30 mA SOT23
V710	4210046	Transistor	BFP182	npn 20 V 35 mA SOT143
V725	4210074	Transistor	BFP420	npn 4. V SOT343
V736	4210013	Transistor	BFP450	npn 4. V SOT343
V737	4210100	Transistor	BC848W	npn 30 V SOT323
V738	4210020	Transistor	BCP69–25	pnp 20 V 2 A SOT223
V739	4217070	Transistor x 2		IMD
V740	4210102	Transistor	BC858W	pnp 30 V 100 mA 200MW
V741	4210100	Transistor	BC848W	npn 30 V SOT323
V755	4210102	Transistor	BC858W	pnp 30 V 100 mA 200MW
V756	4210343	MosFet GaAs	CLY2	MW6
V765	4211485	MosFet GaAs		n–ch 6V V 6V2 A SOT89

V766	4219908	Transistor x 2	UMT1	pnp 40 V SOT363
V780	4110014	Sch. diode x 2	BAS70–07	70 V 15 mA SOT143
V781	4112464	Pin diode	BAR64–04	200 V 0.1 A SOT23
V782	4210050	Transistor	DTA114EE	pnp RB V EM3
V790	4100285	Diode x 2	BAV99	70 V 200 mA SER.SOT23
V791	4210102	Transistor	BC858W	pnp 30 V 100 mA 200MW
V792	4107040	Zener diode	BZX84	5 % 6.2 V 0.3 W SOT23
V800	4110081	Cap. diode	BB640	28/1 V SOD323
V801	4210066	Transistor	BFR93AW	npn 12 V 35 mA SOT323
V802	4210066	Transistor	BFR93AW	npn 12 V 35 mA SOT323
V840	4210066	Transistor	BFR93AW	npn 12 V 35 mA SOT323
V841	4210066	Transistor	BFR93AW	npn 12 V 35 mA SOT323
V842	4110018	Cap. diode	BB135	30 V SOD323
D181	4346010	IC, SRAM		32kx8 bit 70 ns TSO28
D184	4342282	M28c6		4C150 EEPROM 8KX8
D185	4340201	IC, flash memory	E28F008	TSO40
D191	4340126	IC, 1xnand 2input cmos	TC7S00F	SSO5
D192	4340126	IC, 1xnand 2input cmos	TC7S00F	SSO5
D200	4372231	IC, ROM	DSP1616S11	TQFP100
D210	4346012	IC, SRAM		32kx8 bit 70 ns TSO28
D211	4346010	IC, SRAM		32kx8 bit 70 ns TSO28
D230	4370092	IC, D2CA GSM/PCN ASIC		SQFP144
D231	4375937	IC, MCU OTP		SQFP80
N260	4343132	IC, PCM coded/filter	ST5080	SO28W
N270	4375050	IC, RFI ASIC		TQFP64
N271	4375052	IC, PSL+ power supply		SO24W
N551	4370091	Crfrt_st tx.mod+rxif+pwc		SQFP44
N601	4370095	Crfcontf 8xreg 4.5 V vref 2.5 V		VSOP28
N790	4349576	IC, v.conv +1.5–12 V to neg	ICL7660	SO8
N820	4340021	IC, 2xsynth 2g/510 MHz	LMX2331	SSO20
X100	5469792	Syst.conn. q		4DC+JACK+16AF+1RF
X196	5431718	Flexfoil connect		1x30 0.5 mm SMD
X501	9510143	Antenna clip		4D23053 NHK–1XA
	9854056	PC board	DB1	50.0x139.0x1.0 m6 2/pa

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